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FIRE LOSSES AND THEIR PREVENTION

BY

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A thesis

Presented to the Faculty of the Graduate School in
Partial Fulfillment of the Requirements for the
Degree of Master of Business Administration

June 1, 1926.

FIRE LOSS AND FIRE PREVENTION

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I N T R O D U C T I O N

In the upward evolution of man, there have been met numerous forces of obstruction among which fire waste occupies a place of extreme importance. Unlike other obstacles most of which were either subdued or otherwise altogether removed, the "burning" question is insistent and persistent, one that presents itself with ever increasing vigor at every turn of civilization. If it were true that man had left nothing unconquered, there would still be the challenge of fire which had sounded ruination to many a magnificent city in the passing of time.

Realizing the importance of fire, as indeed, a world problem more than one of insurance, and bearing in mind (as it has been told) that the depredation of fire has been far more serious in this country than any other nation on earth, I have devoted Chap. I and Chap. II of this thesis respectively to "Fire and the Losses of Fire" and the "Causes of Fire" in America; Chaps. III, IV, and V to fire prevention work, fighting the causes of fire and fighting the fire itself; and Chaps. VI and VII to the justification and need of fire prevention.

In the preparation of this thesis, I am indebted to various private organizations as well as public

bodies for their generosity in furnishing me with the data required. In general, the unselfish manner in which different associations in America promptly and cordially accede to requests for information and literature is most gratifying. I have also compiled, in the bibliography that follows the thesis proper, a list of books, booklets, bulletins, magazine articles, etc., to which I have made generous reference and from which I have appropriated most of the necessary materials.

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The Graduate School
University of Pennsylvania
June 1, 1926.

FIRE LOSSES AND THEIR PREVENTION

CHAPTER I

FIRE AND THE LOSSES OF FIRE

Conflagration vs. Small Burnings.- The visitations of fire upon mankind may be divided into two main categories: those of enormous magnitude that are sporadic, spectacular, thrilling, and positively disastrous and those of minor proportions that occur unnoticed by most people but that are nevertheless pyramiding day after day and month after month until they aggregate a huge total at the end of a year. The first is usually known as conflagrations; while the second goes by without a name and for the sake of convenience may be called "small burnings". Both of these, although they differ radically from each other in what may be said their "velocity of destruction", have been working hand in hand since the beginning of time to make the lot of man far much harder.

Turning first to conflagrations, history has indeed furnished us with many of these spectacular disasters. The burning of Rome under Nero, of Jerusalem shortly after the beginning of the Christian era, and the Great Fire of London in 1666, may well be remembered by even a casual reader of history. But these are by

no means the only illustrations. There were many times this number that were of the same if not greater magnitude. Lest we forget, let us mention such other conflagrations as those¹ of Sodom and Gomorrah, Troy, Nineveh, Athens, Alexandria, Constantinople, Antioch, Corinth, Moscow, Dublin, St. Petersburg (Petrograd), Belgrade, etc., etc., all of which wrought untold havoc sometime or other.

In America the tale is even a sadder one. Within a few hundred years, there followed one conflagration after another. Thus the night of Oct. 7, 1871, witnessed a most destructible fire which, encouraged, by a high wind, swept all before it for two days until the densest, loftiest, and most substantial part of Chicago had been consumed. Thirteen months later, scarcely had Chicago dried her tears, came another catastrophe, the burning of Boston, which, coupled with the first, cost the nation something like \$243,000,000. But this is not all. A second group of conflagrations occurred between the fateful years of 1904 and 1906 when Baltimore, Toronto, Rochester, and Yazoo were successively reduced to ruins, winding up with the world-famous San Francisco Fire of 1906. The last-named burning, estimated to be as great as the aggregate of all the great conflagrations in the United States for the previous fifty years, was responsible for a staggering loss of \$350,000,000.

1. Spectator Co., Insurance Year Book, Fire and Marine, 1924, p.A-30

But it must not be supposed that big conflagrations were chiefly to blame for the enormousness of the fire waste. It was the innumerable smaller ones which caused the greatest havoc and which contributed largely to amassing the huge yearly tolls. We have little record of the extent of these burnings in past history, but figures from America alone may be sufficient for our purpose. Thus, while the total losses in 1906 with the San Francisco fire included exceeded the five hundred million dollar mark, not a year passed since 1920 without an annual total hovering around the same figure, although there has not been a single conflagration of the San Francisco calibre. During the past five years, for instance, big fires, in the sense of even the Baltimore and Toronto conflagrations, were exceedingly rare. There were but 25 burnings that caused a loss of two million dollars or more, and yet statistics tells us that many "San Francisco's" have disappeared since:

Table I

COMPARISON OF FIRE LOSSES OF 1906
WITH THOSE OF '20-'24 INCLUSIVE ²

Year	Amount
1906 (San Francisco fire included)....	\$518,611,800
1920	500,000,000
1921	495,406,000
1922	521,460,000
1923	535,372,782
1924	549,062,124

A further idea of the large number of small burnings may be had in the records of a city of ordinary size like Philadelphia. The aggregate fire loss in that city in 1924 was a little below \$5,000,000. The total number of fires was 5790. Of this number, 5714 fires were under loss of \$10,000. Tabulated, the distribution is as follows:³

Table II
DISTRIBUTION IN MAGNITUDE OF 5790
FIRES IN PHILADELPHIA FOR 1924.

Magnitude	Number	Per Cent of Total
Under \$10,000	5714	98.68
\$10,000-25,000	40	.69
25,000-50,000	19	.34
50,000-100,000	12	.20
100,000 and over.....	5	.09
Total	5790	100.00

It is apparent from the foregoing that small fires in their aggregate are just as important as big ones. They contribute a major share to making the annual fire losses enormous. Successfully checked, they passed unnoticed, but left unattended to and aided by a strong wind and other "acts of God", any one of them could have developed into a conflagration of any magnitude.

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2. Insurance Year Book, Fire and Marine, 1925
 3. Figures from the Chamber of Commerce, Philadelphia, Pa.

Direct and Indirect Losses of Fire.- Losses resulting from a fire may be direct and indirect. Directly a fire may damage an entire building and demolish its value. It may also destroy a few lives and cause other casualties. But the ill effects of fire are not limited to these. Indirectly there are a thousand and one incident losses that must be considered, losses such as are involved in payment of insurance premiums, maintenance of fire departments and fire-fighting facilities, unprofitable maintenance, rent, rental and leasehold value, demoralization of the standard of living, and expenditures in the direction of fire prevention:

(1) Direct Monetary Loss.- Fire means the destruction of property and as such may be represented in dollars and cents. We have already tabulated the annual losses in the United States for the past few years. It remains now to say that such figures, as they appear in black and white, seem to carry little or no suggestion of their magnitude, but that when they are interpreted more carefully - when we take note that they mean a loss of \$1044 per minute ⁴ which loss is being continued with every tick of the watch - there is food indeed for serious thought:

A per capita representation of these loss figures also reveal the seriousness of the fire situation.

4. R.C. Willoughby, Let's Cost Account Our Fires, Nation's Business, Sept. 1925, p.31

In one sense ⁵ such a representation is suggestive, since the consequences of a fire, though falling directly upon the shoulders of the insurer, the insured as well as the uninsured, are ultimately reflected upon the people at large. They may well be called a fire tax, and statistics tells us that this tax, in terms of a per capita distribution, has been assuming an upward trend in the United States ⁶:

Table III
PER CAPITA FIRE LOSSES IN U.S.
FOR YEARS 1920-1924 INCLUSIVE,
SHOWING A YEARLY INCREASE

Year	Per Capi- ta Loss
1920	\$4.21
1921	4.59
1922	4.63
1923	4.84
1924	4.90

(2) Loss of Human Lives.-- Loss from fire is not confined only to the burning of real estate or personal property. From the humanitarian standpoint, we must mention the countless number of men, women, and children who suffered mentally, physically as well as financially. Not to stress the number of burns and bruises that require medical aid and that in 1924 totalled 17,500⁷, in the same year approximately 15,000 lives⁸, mostly women and children, were lost in fires

5. See Chapter VI, p. 92

6. The World Almanac, 1926, p. 378

of large and small denominations. In other words, in every half an hour a life was sacrificed and more than a limb burned or otherwise rendered useless.

There is of course no adequate basis for determining the loss of this human life value. One can never tell what the life of a human being may amount to. To be specific, however, a conservative estimate of \$1,000 per life would place the loss at not less than \$15,000,000, and in view of the prevalence of claims nowadays for losses of \$10,000 or more as a result of mere automobile accidents, an estimate of \$5,000 to \$6,000 per life would not be at all unreasonable, which would boost the figure to the neighbourhood of \$100,000,000. Even then there remain the 17,500 injuries that must nevertheless be cared for and, more than that, adequately compensated.

(3) Insurance Premiums.-- Fire represents a total loss. No system of insurance can ever restore the lost value. The best that insurance can do is in furnishing an indemnity and thus replacing part or all of the physical loss. But the cost of this service of replacement known as premiums represents a large sum of money. The average annual premium charged for the last five years, 1921-1924 inclusive, by all companies doing business in the United States amounted to \$976,000,000.

7. R.C. Willoughby, "Let's Cost Account Our Fires",
Nation's Business, Sept. 1925, p.32

8. Ibid

Of this sum about half was spent in the payment of claims, while the other half went into various items of importance such as reserves, fire prevention, taxes, agents' commissions, etc. This means that for every dollar of insured fire loss, two dollars must be spent in the form of premiums, - one for actual replacement and the other for loading expenses that make possible such replacement and protection. Still we have left unconsidered the amount of losses not insured and hence not replaced but, notwithstanding, sustained. In the last fifty years, over 27.50 per cent of the aggregate property loss has not been insured and therefore not recompensed.

(4) Maintenance of Fire Departments and Fire Fighting Facilities, - This is another item that swells the fire bill. To help to mitigate fire losses and keep them at a minimum, fire departments are established throughout the country, and fire fighting equipments installed and maintained in every building of considerable size. This incurs an enormous expenditure, and in Philadelphia alone, for every dollar of fire loss in 1924 about another dollar was spent in combatting and checking the spread of fire. The actual cost of fighting fire in Philadelphia in 1924 was as follows:

Table IV

COST OF FIGHTING FIRE IN PHILADELPHIA, 1924.⁹

Annual Fire Loss, 1924	\$4,985,691
Cost of Fire Fighting	4,092,405
Cost of Equipments	<u>2,058,100</u>
Total	<u>\$11,136,196</u>

(5) Loss of Profits, Unprofitable Maintenance, Rent, Rental and Leasehold Value.- The standard fire policy specifically provides that only "direct loss or damage by fire" is protected. The loss of profits on "goods made yesterday" and "goods to be made to-morrow", and of unprofitable maintenance and fixed charges during the period of suspension is excluded. Likewise the loss of rent, rental and leasehold value and a long string of consequential losses are not indemnified. Yet in the majority of cases, it is these consequential losses that work the greatest hardship. Direct monetary loss is sometimes of little moment when compared with the incident losses resulting from unprofitable maintenance, loss of rent and rental value, the tying up of useful capital, and last, but indeed not least, the loss of trade and customers.

To some extent, losses in this direction have been offset by various forms of insurance as use and oc-

9. Figures from the Chamber of Commerce, Philadelphia.

cupancy insurance, profits and commissions insurance, rent, rental value and leasehold insurance. Just the same, such losses are only replaced and not restored. As intangible losses, they are gone once and forever. And in the meanwhile, the price paid for this intangible protection is a heavy one. There is little doubt that for these various forms of insurance the total premiums collected have amounted to enormous figures.

(6) Demoralization of the Standard of Living.-- Emphasis must yet be placed on the effect of fire upon the great mass of people, especially the workmen, who live from hand to mouth. It is very well to picture the distress of capitalists, property owners, and employers, but the suffering of the commonplace must be correctly visualized. Not to mention the vast number of small holders of stocks who are effected financially and otherwise as a factory is reduced to ruins, we must remember the immediate and subsequent loss falling upon the shoulders of the large body of employees whose salary is already none too large. As far as possible, this should be interpreted in all its practical aspects. A story was told¹⁰ of a fair-sized Ohio town, where an extensive plant engaged in a special line of work to produce a certain product was one day swept by fire until it was merely a

10. W.E.Mallalieu, Prevention of Fire Waste, Convention Year Book, 1925, Fire Casualty and Surety, p.24

blackened ruin. It happened that the owners decided not to rebuild the factory and the thousand and more employees were thrown out of work. Not being skilled in any other line of endeavour, their impoverishment soon became apparent. Savings bank balances and building and loan accounts had to be drawn upon; purchases of merchandise were abruptly curtailed; insurance policies were cancelled, defaulted or surrendered; landlords had to wait for their rents or go without; amusement business fell to practically nothing and church contributions were at a minimum. Not long later there began an exodus to other places where work was to be had; children were taken from the schools and families were disrupted. Eventually the town became only a shadow of its former prosperous self. Such a situation is not impossible. It shows conclusively how fire may disrupt and demoralize even the entire social structure.

(7) Expenditures in Fire Prevention.-- Fire prevention work is not confined only to the mere process of fire extinguishment. Its very name indicates that it aims at the prevention of fires. Toward this end, numerous organizations, both public and private including associations of underwriters who are primarily concerned, have been working unceasingly for the past few decades. The maintenance of these organizations cost no little money;

their activities and propaganda work including the following up of this propaganda also constitute a large item of expense. Disbursements of the National Board of Fire Underwriters alone have reached the large sum of upwards of one million dollars annually.¹¹ Reference must be made also to the vast sums of money spent in the construction of so-called "fire-proof", "semi-fireproof", and "slow-burning" buildings, the purchases of fire safe furnishings and apparatus, the enactment and enforcement of legislative regulations and requirements, and in short the various factors¹² of fighting the causes of fire as against those¹³ of actually combatting the fire itself. Were it not for the constant imminence of fire, such expenditures could have^v been dispensed with and the money turned into channels of legitimate industry.

Analogy of Fire Losses.- To bring out the importance of fire losses, absolute figures sometimes do not fit the purpose. Few people understand or care to understand what a nine-figure loss amounts to. To the average rank and file, the mere fact that the fire bill for 1924 in the United States exceeded \$500,000,000 carries little or no suggestion at all. But the significance of

11. J. B. Levison, Fire Insurance and the Public, Convention Year Book, Fire, Casualty and Surety, 1924, p. 83.

12. See Chapter III.

13. See Chapters IV and V.

this figure can be better grasped if it is worked out on the basis of an analogy. Thus allowing that all direct and indirect losses in 1924 did not exceed ten times the reported figure - which estimate is not at all too radical - the corrected annual loss for 1924 would be upwards of five billions. If then these five billions of tribute money were piled up on one side of a road to be paid one dollar at a time on the other side of the road, and if one man began the job, carrying a dollar across the road every minute day and night the payment would require seventy-nine generations of man, each one beginning to work immediately as he was born and continuing so to work until the age of 100. In other words, the labour would consume a period of 9514 years, which means that if the work had begun 7000 years before Christ, it will have to be continued until 588 years hence, or A.D. 2514. Interpreting the figure in still another way, this towering pile of dollars would pay for 15 Panama Canals, would pay the salaries of all teachers and school superintendents in the United States for seven years and a half, would buy an enormous merchant marine of 100 gigantic liners at \$5,000,000 apiece, or would suffice to carry the United States through perhaps another great war. And yet the direct toll of fire in America alone reaches this figure within a single year.

CHAPTER II
THE CAUSES OF FIRE

Specific Known Causes.- With a view to unrooting the causes of fire, the Actuarial Bureau of the National Board of Fire Underwriters has been laboriously engaged, ever since its inception, in compiling data relating to the causes of fire. Their compilation has been useful not only in making possible an equitable rating of risk but also in the formation of a definite program of fire prevention designed to exterminate the causes of fire. Their tabulation of the causes of fire in 1924 was as follows:

Table V

AMERICAN FIRE LOSSES 1924

<u>Known Causes:</u>	
1. Exposure	\$60,145,047
2. Matches - Smoking	30,281,840
3. Defective Chimneys and Flues	22,746,308
4. Stoves, Furnaces, Boilers and their Pipes	21,160,369
5. Spontaneous Combustion	17,037,454
6. Sparks on Roofs	15,052,140
7. Electricity	14,579,757
8. Lightning	11,680,516
9. Petroleum and Its Products	11,619,306
10. Sparks from Combustion	9,354,570
11. Sparks from Machinery	8,819,239
12. Hot Ashes and Open Fires	6,146,304
13. Miscellaneous Known Causes	4,286,443
14. Open Lights	4,282,640
15. Gas, Natural and Artificial	3,376,808
16. Incendiarism	2,368,301
17. Explosions	2,237,803
18. Ignition of Hot Grease, Oil, etc.	1,804,080
19. Rubbish and Litter	1,355,234
20. Fireworks, Firecrackers, etc.	904,825
21. Steam and Hot Water Pipes	290,628
<u>Unknown Causes</u>	<u>189,720,087</u>
Total	<u>\$439,249,699</u>

Classification According to Prevention.-

It is evident from the foregoing that the causes of fire may be classified, as suggested by the National Board of Fire Underwriters, into two grand divisions, namely: (1) those that are strictly preventable and (2) those that are partly preventable. There is no hard and fast rule, it is true, that distinguishes between these two classifications; but a general apportionment of the causes should be as follows:

STRICTLY PREVENTABLE CAUSES:

Matches - smoking; defective chimneys and flues; stoves, furnaces, boilers and their pipes; sparks from roofs; petroleum and its products; hot ashes and open fires; open lights; gas, artificial and natural; ignition of hot grease, oil, tar, wax, asphalt, etc; rubbish and litter; fireworks, fire-crackers; steam and hot water pipes.

PARTLY PREVENTABLE CAUSES:

Exposure; spontaneous combustion; electricity; lightning; sparks from combustion; sparks from machinery; miscellaneous causes; incendiarism, and explosions.

Following this classification and applying it to figures for 1924, it can be readily seen that a large percentage of fires was within the possibility of prevention. As the accompanying table shows, about 27 per cent were strictly preventable, 30 per cent partly so, and it is probable that the 43 per cent unknown causes were also largely preventable.¹

Table VI

DISTRIBUTION OF CAUSES ACCORD-
ING TO PREVENTION, 1924

Causes	Amount	Per Cent of Total
Strictly Preventable	\$119,020,482	27
Partly Preventable	130,509,130	30
Unknown (Probably largely preventable)	189,720,087	43
All Causes	\$439,249,699	100

Statistics from a large city like Philadelphia attest even more forcibly to the possibility of a large number of fires having been prevented. According to records compiled by the Fire Insurance Patrol of that city, 2007 dwelling fires were reported to have occurred in 1924. Of this large number 29.80 per cent were traceable to matches. Another 7.94 per cent were attributable to smoking and cigar and cigarette stumps, 8.11 per cent to lamps and candles, 8.62 per cent to gas, gasoline and their appliances, 13.07 per cent to chimneys and defective flues, and 18.87 per cent to heaters, hot ashes, open grates, ovens, ranges, stoves and rubbish. In other words, these six types of causes

1. In this connection figures for an earlier period bear us out more conclusively. According to the computation of the National Board of Fire Underwriters as given in Dr. S.S.Huebner's text on Property Insurance, pp. 296-297, the percentage distribution for 1918 was: Strictly preventable, 43%, Partly preventable, 34%, and Unknown (largely preventable) 23%.

occasioned some 86.41 per cent, or more than four-fifths of all dwelling fires in Philadelphia during 1924.

Intangible Causes.- In addition to the immediate and physical causes that are directly traceable, there are other causes, which, though, intangible, are none the less mainly responsible. They contribute their part by making possible first, the occurrence of a fire and second, its continuation. Often, a multiplicity of such causes exist. An excellent illustration may be found in the burning of San Francisco. It mattered not what was the chief and immediate physical cause in this case, since on the eventful night of April 18, 1906, fire broke out in some forty points in the city. Earlier on the daytime, an earthquake, - an "act of God" - , had visited the city and broken some of the water mains. But to these various causes, we must add weightier ones. Thus, it was reported in the findings of a committee of twenty appointed by the National Board of Fire Underwriters that² "San Francisco had violated all underwriting traditions and precedents by not burning up,² and the prediction was made that "even the vigilance of a fire department could

2. H. C. Brearley, Fifty Years of Civilizing Force, pp. 97-98

not be relied upon indefinitely to stave off 'the inevitable'. Interpreted in another way, this means that through the long years of peace and comparatively little immunity from big conflagrations, the city had permitted a complexity of intangible causes to take root. The construction of buildings had been at fault; an enormous exposure hazard had been developed; the water supply, so vitally necessary, had not been carefully planned and preserved; and lastly the city ordinances had been far too laxitive. None of these causes could one solely accuse, as, while they were not individually mainly responsible, all of them contributed a due share.

In the same way, we might view each annual loss as a yearly conflagration of the San Francisco calibre with an equal, if not greater, multitude of intangible causes in addition to other immediate physical instruments as the careless handling of a match or the over-turning of a kerosene burner. The intangible causes are made up of the following:

(1) Carelessness, Indifference, and Mismanagement.- Earlier in the chapter mention was made of the classification of causes according to their plausibility of prevention. That a fire was strictly preventable and yet was permitted to occasion much damage is a glaring evidence of carelessness and indifference. Matches and smoking, an indication of gross negligence, have been tenaciously occupying the second place in the

list of known causes. The Baltimore conflagration of 1904, costing the nation \$50,000,000 and devastating an enormous area, was believed to have been caused by a lighted cigarette stub being thrown through a sidewalk grating. In 1924 persistent pyramiding of blazes of this origin was responsible for a monetary loss of \$30,281,840. In Philadelphia alone, as shown previously, it was responsible in 1924 for more than 38 per cent of all dwelling house fires, and accounted for 2208 out of a total, 5790, of all burnings.

Other indices of carelessness may be found in the list of strictly preventable causes outlined above. It is interesting to note the way they clung tenaciously to their respective positions year after year. Much advance may have been made in other directions of fire prevention but the mental attitude of the rank and file is still one of carelessness and indifference.

(2) Construction.— In explaining the wide and widening disparity between European and American fire losses, the chief reason has been attributed to the methods of construction. Long ago Europe saw the end of its lumber supply and adopted stone and steel and other incombustibles as its structural materials. The wisdom of this, as pointed out by the New York Times³, was demonstrated in

3. New York Times, June 28, 1925, p.2

the World War when few disastrous fires resulted from German shells and bombardment, whereas were America to exchange position with Belgium or France, the result would have been inconceivable.

It must be understood, of course, that there are in this country many buildings, mercantile as well as industrial, in which the principles of fire prevention have been most carefully applied. As a class the fire record of these buildings is undoubtedly excellent. Unfortunately still, in practically all of the American cities,⁴ the great majority of buildings are still of wooden construction and of such character as to offer little resistance to the spread of fire.

Out of faulty construction grows an enormous hazard, that of exposure, which has almost always been the ranking cause of fires in past years. It brought about a loss in 1924 double in magnitude that of its nearest rival and may be held accountable for at least one-fourth of all the losses from the twenty-one classified known causes. By an exposure fire we mean a communicated fire and its toll has been especially large because, as pointed out by Mr. Dean, originator of the "Analytic System for the Measurement of Relative Fire Hazard,"⁵ an exposure hazard may be (a) radiated, (b)

4. G.W.Booth, Safeguarding America Against Fire, Sept. 1925, p.2

5. S.S.Huebner, Property Insurance, p.255

absorbed and (c) transmitted.

Along with this tremendous exposure hazard may be mentioned the danger of too great a concentration of risks. Industrial and commercial amalgamation has brought with it the tendency of amassing huge capital in one single location. Observe the number of so-called "skyscrapers" along the city line of New York. Industrially and commercially concentration of this nature may mean economy and all the advantages of large scale production, but where all the eggs are put in one basket there follows the possibility of having them smashed all at a single point of time. Once fire protection is let down and a fire permitted to ravage in even one of these mammoth buildings, the damage would simply be disastrous.

Other evidences of faulty construction may be found in the prevalence of defective chimneys and flues, unguarded vertical openings, shingle roofs, etc. They are among the leading causes year after year, and must be successfully combatted before America and any other country can expect a lower fire loss.

(3) Absence of Restrictive Legislation.- Another principal factor in the causing of fires is the absence of or the inadequacy of fire prevention ordinances. Most new buildings, it is true, have been carefully regulated from the standpoint of fire prevention, but this

applies only to new buildings and old ones are permitted to remain as they were. Good building ordinances are still in the making, and even when they have been made and passed, they have yet to be strictly enforced.

Another feature in this connection is the absence of personal accountability in case of a fire. In America, a fire is regarded as a misfortune and a man who has one deserves the sympathy of all. On the contrary, in the European continent any fire is considered a crime, and the one causing it, no matter whether he is the tenant or the owner, the builder or the architect, is held strictly responsible, not only for the loss on the property in which the fire originates but also any damage on other adjoining properties necessarily exposed. Thus the Code Napoleon, prevailing especially in France and Belgium and forming the basis for the modern law in most Latin countries, contained two sections as follows⁶:

Article 1382: Any person is responsible and liable for any acts of his by which any other person has or may have sustained any loss, damage or injury.

Article 1383: Every person is responsible for loss, damage or injury caused by his own act, carelessness or negligence,

A striking illustration of the benefit of good building ordinances and personal accountability in case of a fire may be cited in the experience of Frankfurt of Germany as compared with that of any city of

6. Safeguarding America Against Fire, Sept. 1925, p.3

similar size in the United States.⁷ Frankfort has a population of 465,000. The number of fires a year is about 470, whereas in a city of that population in America, the most conservative estimate should be placed at four times this number. At the same time, the municipal fire department in Frankfort comprises 277 men; while Newark, New Jersey, a city of about the same population, employs 711 fire fighters and had a record of 3025 alarms in 1923. The difference, as explained by the National Board of Fire Underwriters, was not due to an inferior fire fighting ability of the American fire department, but to a great extent to the system, as in Frankfort, of a rigid investigation and inquiry, and also to the strict enforcement of regulations, prohibiting the erection of buildings over 72 feet in height, prescribing materials of construction, the storage of hazardous substances, and the construction of stairways, exits and lighting installations.

(4) Arson and Incendiarism. In the broadest sense, as suggested by Mr. F. R. Morgeridge⁸, a person is guilty of arson who wilfully or maliciously or with intent to defraud (the insurer) attempts to burn or sets fire to, or burns or causes to be burned or who aids,

7. Ibid

8. F.R.Morgeridge, "A Model Arson Law", paper read before the Fire Marshals' Association of New England, and published in "Safeguarding America Against Fire", November 1925.

counsels or procures the burning of dwellings, buildings and other property (such property being of the value of 25 dollars and the property of another person). Even without this broad interpretation, incendiarism has been seriously frowned upon by people at large. Heavy penalties have been exacted upon culprits whenever discovered. Thus writes the National Board of Fire Underwriters:⁹

"Of all the crimes, human, inhuman, and puterhuman that have befouled the dockets of American law courts, none but murder is quite so base and so slinking as arson. In one respect, indeed, it even exceeds in heinousness the capital offense, for, unlike murder, arson by its very nature can scarcely be committed except in cold blood."

Inspite of the severity with which it has been dealt, incendiarism stood responsible for a total loss in 1924 of \$2,368,301. This is relatively small when we consider the grand total of all causes. Unfortunately a potential factor lends itself to the explanation of this apparent smallness. Unlike other causes, incendiarism does not appear on the list as an incendiary fire unless it has been so discovered and convicted. The real incendiary figure, therefore, is concealed somewhere in the large item of unknown causes, and in fact, as will be shown later, has been be-

9. Safeguarding America Against Fire, Nov. 1925

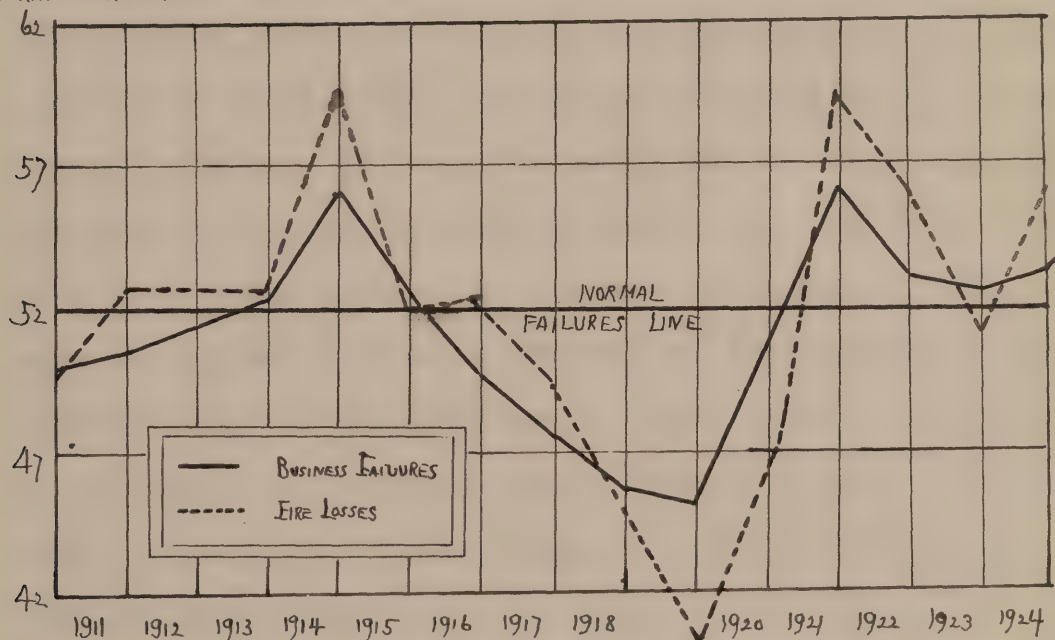
lieved to constitute the major number of fires the origins of which are unknown or otherwise doubtful.

There are other factors at work helping to promote the course of arson and incendiarism. Business failures, as will be discussed in a later section, have been blamed for engendering incendiarism. The chief factor, it seems however, is found in the system of insurance whereby a successful incendiary can secure indemnity on a worthless piece of property which he set on fire. Two other situations are also responsible for facilitating the work of this professional firebug, namely, first, the operation of the valued policy laws in a few states which require the insurer to pay the full amount of the policy in spite of violent departure of the insured property from actual market value, and secondly, the unwarranted tendency on the part of agents and companies to permit over-insurance. With respect to the latter, it may be said indeed, that while under insurance means caution, fair insurance means care and full insurance carelessness, over insurance carries with it the possibility of fraud.

(5) Business Failures.-- The theory has been advanced that business failures bear a close relationship to the occurrence of fires. Statistics that have

been collected in this direction seem to attest to this suggestion. As may be seen in the accompanying diagram,¹⁰ business failures and fire loss of unknown causes have been most directly correlated to each other during the past fifteen years:

FIRE LOSS RATIO PER CENT



10. Chart originally prepared by the Glens Falls Insurance Co., Glens Falls, N.Y., and appearing as an advertisement in a number of important insurance papers under the heading: "Incendiarism, 40%".

Before accepting this correlation as an indication of incendiarism although there is every reason so to do, it may be said, however, that just as business depression and failures may prove to be the cause of an increased number of fires, a large number of fires may also be the cause in bringing about the foreclosure of many business enterprises. In other words, the relationship of the two is reciprocal, the one not necessarily the cause or the effect of the other. Fire insurance, we all know, does not furnish complete protection. Once a plant is burnt down, or partially destroyed, it is put out of running. It requires money and courage to meet the continuing unprofitable expenses and even when these have been taken care of by various other forms of insurance as use and occupancy insurance, the problem of reconstructing the business on a gigantic basis as before is no small one. A well-to-do industry cannot recover from a fire shock without much struggling, whereas a weak and unprofitable one is bound to succumb.

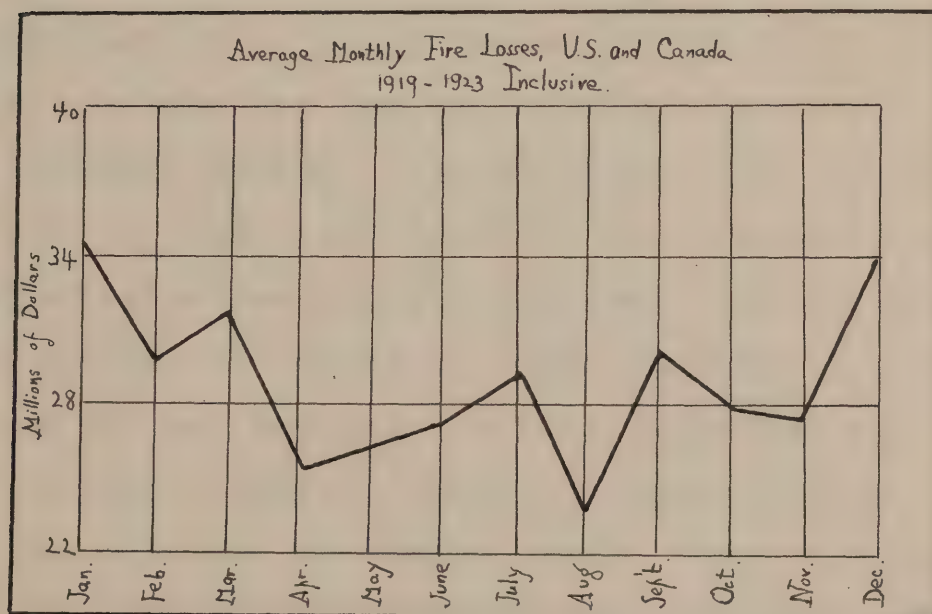
Notwithstanding this contention, it can be argued with every good faith that business depression, - the fact that a corporation is not doing well - has every effect, visible or invisible, upon the activity of the fire demon. Aside from the fundamental economic causes, the chief reason for the undoing of a business

corporation, as discussed by Prof. Dewing,¹¹ is the lack of a good management. Hence one may reason that under a "bum" management, fire fighting and fire protection problems are all cast into oblivion. Psychologically speaking, in time of lean years, when credit is strained and every other thing looks dark and gloomy, the management would spend every coin in its treasury to strengthen its position rather than to install, let us say, a system of sprinklers which may be absolutely necessary. As a result, the building is permitted to decay and deteriorate, fire fighting appliances are neglected or ill-kept, and there is a general letdown in fire prevention work. Further, incendiarism may actually come into play, and unprincipled business heads may not hesitate in setting fire to their establishments in order to realize on the insurance they may have been carrying. All these factors, theoretical as they may seem, are perfectly tenable. It remains now for honest policyholders to see that their money does not go into the pocket of the incendiary.

(6) Seasonal and Climatic Influence.-- The effect of weather is also reflected in the number and magnitude of fires. It may be noticed that in time of cold weather, fires are much more frequent and generally

11. Dewing: Financial Policy of Corporations, Vol. V, p.11

are of greater magnitude. In cold winter months, even a casual reader of the daily paper will observe some headline or other on the losses of fire and its incident toll of human lives. A graph prepared from the average monthly losses for ^{the} past five years, 1919-1923 inclusive, in the United States and Canada, is presented as follows:



It may be seen from the diagram that the curve rises in the months of December and January at

which time one finds the first test of winter. The weather continuing to remain cold during the following months, February and March, the curve, inspite of a short drop in the present instance, likewise stays above other months. As the thermometer ascends in the remaining months, the number of fires gradually falls off until it reaches the lowest point in the month of August.

To explain this phenomenon, quite a few solutions are available. In the first place, it is in winter months that people turn to the company of a warm fireplace. Heating appliances, which have been discarded or stored away for so long a time as to have become defective, are taken out from their hiding places for purposes of emergency heating. Heaters ranging from the very safe to the very unsafe come into use. Psychologically, people become less vigilant, and even a employed watchman may, against his conscience, relax his watchfulness and prefer the warm beddings to a trip around the premises in the face of snow and frost. To these forces we may add the effect of the weather itself. When Jack Frost and the fire demon work hand in hand, the lot of the fireman is the hardest. Allowing that every fire-fighter is ^csonscientious to his duty, account must be given to the terrible struggle against snow and stingy^{ing} cold on the way to the place of conflagration. The accumulation of several feet of snow may also materially affect the

speed that is so vital. Further, in a temperature below zero, the water supply may be greatly affected. All these help the fire demon in his warfare upon mankind and offer an explanation why fire losses in cold months are above normal.

Another seasonal factor, though not directly the result of cold weather or climate, that may be called a cause of fire is found in holidays and vacations. Figures for 1924 show that there is a large item, \$904,825, charged to fireworks and firecrackers, an indication of the celebration of holidays. From statistics compiled by the Journal of the American Medical Association,¹¹ 749 deaths were incurred in the celebration of Independence Day for the years 1903-1916 inclusive. Of this number, 227 were burned to death, 208 killed by firearms; 119 by explosives; 59 and 52 respectively by giant crackers and toy cannons, and 84 by various forms of fireworks. Christmas, an occasion of joy, proves sometimes to be the cause of mourning. Christmas trees are often made of dried, crackling branches, decorated with cotton wool, cut paper and celluloid ornaments, and often equipped with burning candles. The application of a slight spark of fire will easily set the whole fixture ablaze. This cost of enjoying festivals is especially evident in Oriental countries where, on important occasions of festivity, fire departments are often reinforced and

11. Safeguarding the Home Against Fire, by
the National Board of Fire Underwriters,
pp. 82-84

kept on duty full-time in anticipation of fires developing from the offerings of incense and candles to appease the hunger of the gods.

(7) Special Fire Causes.- In this connection reference is made to special fire hazards peculiar of individual industries. It is clear that a cotton mill has principal hazards characteristic of the industry, while a paper plant possesses another set of totally different risks. Suffice it to say that each industry has its own causes to look after which, in the interest of brevity, we shall not dwell upon in a thesis of this nature.

CHAPTER III

FIRE PREVENTION - FIGHTING THE CAUSES OF FIRES

Scope and Extent.-- Thus far we have presented the humiliating phases of the fire waste problem. True, year after year there has been an increase, absolute as well as relative, in the records of fires. But it would be a grave error to suppose that the seriousness of this situation could have been ignored. The truth is that in the past one or two decades America, just as other countries, has exerted every possible ounce of her energy in grappling with the problem. And, as will be shown in a later chapter, these efforts have not been expended in vain.

A study of fire prevention work at once brings up two aspects of the problem, namely, fighting the causes of fires and fighting fire itself. The two are more or less allied in certain individual instances, but as a whole are quite distinct one from the other. To be specific, the word "prevention" relates to the first. It means the smothering of the possibility of fire, involving, as from the fire engineering standpoint, the observance of proper methods of construction of buildings, avoidance or removal of unnecessary fire hazards and intelligent segregation

and safeguarding of hazards which are necessary to the conduct of certain industries or are inseparable from them. The second pertains more to the extinction of fire either in its incipency or after it has been started for some time. It includes problems bearing upon the control and extinction of fires, and covers, for example, design, installation, and maintenance of apparatus and equipment employed to extinguish fire or oppose its progress.

It may be stated at the outset that the problem confronting the student of fire prevention is one pertaining to the intricacies of engineering. As such, volumes and volumes may be written on the subject. In the following presentations, therefore, the writer will ^fregrain from delving into engineering topics wherever possible. The attempt will be made only to offer a general outline of the various subjects.

Factors in Fighting the Causes of Fires.-

The various factors essential in fighting the causes of fires relate principally to the following: (1) Educating the public; (2) Fostering good management and housekeeping; (3) Improving the existing methods of construction; (4) Agitation for healthy public regulation with particular emphasis on good building ordinances and personal liability codes; (5) Equi-

table and scientific rating of risks; and (6) Co-operative effort in the formation of organizations and societies for fire prevention.

(1) Educating the Public. It is of paramount importance that the average rank and file be instructed in the elements of fire prevention. In order to reach the most deadly of all the causes, indifference and carelessness, the interest of the people must first be enlisted. They must be shown the magnitude of fire losses with their serious aftermaths. The causes of fires may then be explained to them, to show that such fires are largely avoidable.

A convenient way to reach the public is by the use of newspapers, bulletins, magazines, periodicals, and pamphlets. Editors have now become aware of the fire peril and have permitted different fire prevention literature to appear in their journals. Through repeated printing of news stories relating to fires and the losses of human lives because of fires, the daily paper has engendered in the minds of the millions of readers a spirit of fear and of co-operation. In addition, various magazines pertaining to the questions of safety engineering, fire prevention, and good house-keeping have been found in the market. These, with other bulletins and pamphlets published by insurance

companies and other organizations, should help in bringing added emphasis on the "burning" question.

As a further means of creating and stimulating public attention, speeches and lecture tours may be conducted. And, as a custom in America, a certain period of the year may be designated as the Fire Prevention Week. The latter affords a fitting occasion for the spread of fire prevention literature and should serve as a starting point of a vigorous program to be continued throughout the year.

To bring home the importance of fire prevention in the minds of school children whose playfulness has many a time resulted in disastrous fires, systematic fire prevention education in the schools, in contrast with voluntary education which, at best, is accessible only to a limited number, is necessary. By teaching the young people when they are young, habits of carefulness and a sense of responsibility may then be developed. Several states in the United States have already incorporated courses on fire prevention in their school curriculum, and it is quite possible that the country at large will soon follow their example.

In all this propaganda, the practical side of fire prevention must be emphasized. As far as possible, the rank and file must be taught in the main-

tenance and use of alarm systems and other protective devices. A business firm may have spent thousands of dollars on the installation of a water sprinkler, but the mere negligence of an employee in not turning on the water supply may leave the entire system worse than useless. Likewise, there may be numerous fire alarm boxes in a modern town, but inability to use such devices correctly and at the vital moment is disastrous. The layman is often not as knowing as he is taken to be; he must be duly instructed at all times.

(2) Fostering Good Management and Housekeeping.--

Good management and housekeeping also deserve attention. Fires often start themselves in the most unthought of places. By exercising ordinary care and diligence, the housewife can avoid most, if not all, of the common causes of fires. In like manner, the business head must use discretion in safeguarding his plant or factory. Where risks are preventable, they must be prevented; where science has not yet found a remedy, risks that are hazardous must be segregated and the ensuing fires confined to their places of origin.

To reach this end it is important that correct types of utensils be used. Safety from the fire prevention standpoint must be the criterion governing the purchases of furniture and other appliances. It

is unthinkable, for example, how numerous hazards are connected with an ordinary kitchennette. Cookery, with all its merits, has been a costly art, having played many an important role in various conflagrations. It goes without saying therefore that proper cooking utensils and stoves should be installed.

The business man faces a somewhat similar situation. Problems of heating, lighting, ventilation, and equipment are present in every business concern, and each of these involves a fire hazard. The necessary equipment must be judged from the fire standpoint, and after purchased must always be kept in the highest stage of efficiency. Fire prevention appliances, if installed, have to be maintained properly in order to be as reliable as possible when emergency requires their use.

In connection with the foregoing, mention must be made of the Underwriters' Laboratories, with its branch offices, which has done most in promoting the use of safety articles. To this organization come thousands of products of hundreds of manufacturers and there they are put through a series of most exacting tests by means of scientific apparatus and under the eyes of trained experts. To these makes of articles, after they have passed through thorough tests and proven

their worth, is affixed the seal and label of the Underwriters' Laboratories, a symbol of safety. Consequently, the choice on the part of the housewife or the business head between an article that has been so tested and one that has not may mean either the checking of a fire or the introduction of a very bad risk.

(3) Improving the Existing Methods of Construction.- Reference was made in an earlier chapter to inferior construction as a material factor in the heaviness of fire losses in America. Following the practice of mankind, wood, because of its cheapness and abundance and inspite of its burning capacity, has been freely used in the construction of floors, partitions, roofs and walls. That this has taught the world a costly lesson is evidenced by numerous conflagrations. Nowadays buildings may be grouped, from the fire standpoint, under one of these four heads: (a) fire-proof; (b) semi-fire-proof; (c) slow-burning; and (d) ordinary.

(a) Fire-proof. The term "fire proof" is a misnomer. Literally considered, its full meaning places no limit upon the duration or the intensity of the fire. This is manifestly impossible, as human intelligence has not yet discovered a material or a combination of

materials which will withstand, without damage, the application of fire and heat of unlimited duration and intensity. This was proved most convincingly by the experience of the Boston and San Francisco fires. In both of these conflagrations so-called fire-proof buildings were either seriously damaged or else actually razed to the ground.

Evidently enough the term "fire-proof" should be applied to buildings so designed and constructed as to offer satisfactory resistance to ordinary fires and conflagrations. Bearing this in mind, a fire-proof building may be defined as a structure consisting of a steel cage, with the structural members safely insulated against heat from within or without the building. It may also be of reinforced concrete construction, of an approved concrete mixture reinforced by steel of any shape so combined that the steel will take up the tensional stresses and will resist heat when properly insulated.¹ There are also other specifications as recommended by the Committee on Fire-proof Construction of the National Fire Protection Association,² with regard to brick bearing walls, exterior non-bearing walls for skeleton construction buildings, "fire division" walls, column covering, girder covering, floor

1. Corsby-Fiske, Handbook of Fire Protection, pp. 9-52

2. Spectator Company, Fire Prevention and Protection, pp. 7-24

beam covering, spacing of floor beams, material of arches, floor openings, partitions, finish, roof covering, superstructures, skylights, water-proofing of floors, tanks, etc. In short, the purpose of such requirements is to isolate, in case of a fire, a building from another and a floor from all others so that the building will not be affected^t by a fire from the outside, and that other floors will not be damaged by the burning of combustible materials on any floor.

(b) Semi-fire-proof.- Semi-fire-proof buildings come into existence where cheapness of construction is desired and where building codes are more or less lenient as to permit their erection. The materials used are also non-inflamable and the building is equipped with structural or tension metal members which, however, are not properly insulated and therefore non-resistive to heat. This is done on the theory that the building will not house a large quantity of combustible stock as to generate, in case of emergency, an enormous amount of heat that may seriously derange the iron work of the building. Ordinary office buildings and dwelling apartments answer this description well and so are often constructed on a semi-fire-proof basis.

(c) Slow Burning or Mill Construction.- Another type of buildings, related to fire-proof but con-

constructed on differential principles, is the slow burning construction. Its whole purpose is such as to retard the progress of fire so that, under normal conditions, the fire department will reach the scene on time and has the fire under control before it gets under considerable headway. It is also known as Mill Construction, because it was first exploited upon among the New England textile mills and was recommended by mill insurance companies as making as good a risk when accompanied by sprinkler protection as a fire-proof building.

Birefly speaking, the principles of mill construction are three in number.^{3,4} First, by the use of heavy planks between stories it attempts to retard the progress of fire from one story to another. Thus, all openings in and between floors such as belt holes, stairways, elevator shafts, etc., are eliminated and separately encased in cut-off towers. Secondly, the timbers and flooring required to give the necessary stability and strength are arranged so as to offer as smooth a surface and as few corners on which fire may feed as practicable. Very heavy floor timbers, spaced 8-12 feet apart and floors of three to four inch planks, with sin-

3. Crosby-Fiske: Handbook of Fire Protection, pp.41-42

4. Wentworth, F.H.: Factories and Their Fire Protection, pamphlet published by the National Fire Protection Association.

gle or double top boarding, are used. In a building of this type fire can be reached with water from either hose stream or sprinkler. Lastly, the floors in a building of this type are tight as well as heavy so as to prevent fire and smoke from working through.

(d) Ordinary Buildings.— America still abounds with buildings of the ordinary type. They are of inferior construction to any of the three above. However, as such they are not necessarily poor risks. Common sense on the part of the engineer in their construction may go a long way in making them much less hazardous. As remarked by a certain fire engineer,⁵ even dynamite is fire resistive to a certain extent. Undoubtedly, not all of these common buildings are tinder boxes. Properly constructed and cared for they make good risks.

It will take many long years, if not centuries, before America, or any other country on earth, can eliminate this type of buildings forever. Such a time may never come. In the meanwhile, improvements made on these buildings may help materially in reducing the fire waste. Ordinary buildings, with their skylights and other vertical openings properly protected, with windows and roofing that are fire resistive, and furnished with even cheap fire protective devices as water pails and chemical fire extinguishers, are not very undesirable

5. John Stephen Sewell, chap. on Fireproof Construction, Handbook of Fire Protection, p.7.

from the fire standpoint. In fact, it must be remembered that to the huge class of bourgeoisie only this kind of buildings is available.

Construction of Special Occupancies.- Mention must be made of the various types of special occupancies existent. In this country there are countless department stores, car houses, power stations, theaters, dwellings, warehouses, garages, and numerous manufacturing establishments. All of these present different engineering problems. Suffice it to say, with Mr. F.H. Wentworth of the National Fire Protection Association⁶, that in planning a factory, as in other special occupancies, experience in fire protection engineering has suggested three points to be kept in mind:

1. There should be as little combustible material as possible in its construction and equipment.
2. Each floor should be absolutely cut off from every other floor and each section from every other section so that fire may not communicate.
3. Every part of the building should be equipped with fire extinguishing apparatus.

To these three if we should add a fourth idea, that of properly safeguarding the building from outside exposures, we would have met well the general re-

6. F.H.Wentworth: Factories and Their Fire Protection,
p.5

quirements of fire resistive construction.

(4) Healthy Public Regulation.-- Human instinct the world over is prone to trifle with matters when they are left to their volition. Such indifference in the matter of fires is criminal, since it endangers not only the lives and property of one family but also those of other families. It is only fitting that wherever possible the strong arm of the law reaches in and sets down positive requirements in black and white. Such requirements have been recommended in various fire prevention literature. The leading ones, as compiled by Dr. S.S.Huebner⁷, are the following:

(1) Creation of the office of fire marshal, with definite duties and powers relating to the making and enforcement of regulations;

(2) Adoption and enforcement of good building ordinances;

(3) Licensing of occupancies and use of extra hazardous materials and processes;

(4) Compulsory introduction of automatic sprinklers;

(5) Utilization of various public departments for service in fighting and preventing fires;

(6) Personal liability of responsible parties.

7. S.S.Huebner, Property Insurance, pp.308-309

The importance of most of these suggestions is indicated in various sections of this thesis. Emphasis need be placed here on the adoption and enforcement of good building ordinances and the establishment of a rule for personal liability of responsible parties. The first makes better construction possible, and the latter serves a double purpose: curtailing incendiary fires and checking fires caused by gross carelessness.

We have seen how in the European continent, there are good building laws in addition to the Code Napoleon which holds the responsible parties liable. To a large extent this has also been the case in the Orient. In Chinese law codes, for instance, incendiarism is analogous to murder and is punishable with the same degree of severity. Further, ancient Chinese laws held an official strictly accountable for any fires in his district. Many a time officials were automatically demoted or summarily dismissed as a result of devastating fires in their districts. In Japan, we have been told,⁸ as late as 1866 death by fire was the punishment meted out to incendiaries. America, then, is the only nation that has been particularly lenient. For this unwarranted leniency, America has been paying an enormous fire bill year after year.

8. F.C.Gillespie: Fire Protection and Fire Insurance in Their Relations to Political Economy, p.11

Conscious of this situation, leading fire prevention experts in America have heartily endorsed the suggestion of making individuals legally liable. Unfortunately the idea has not progressed beyond the minds of these limited few. Evidently the suggestion has met with various obstacles, legislative and otherwise, as responsible organizations, despite the fact that they conceded⁹ the proposed measure to be "exceedingly effective", "very educative", and "worthy of careful thought" have hesitated to recommend its positive adoption.

(5) Equitable Rating of Risks.- "Education via the pocket book", as the present systems of rating have been called, is an effective as well as an interesting way of fire prevention. The uninformed is often bewildered why, inspite of apparent similarity of conditions, the rate on his property is sometimes so much higher than that on his friend's. His inquisitive nature may start an investigation, and in the end he should come out satisfied that the insurance business makes no discrimination whatever between individuals but that his rate is composed with reference primarily to three main factors: (1) the acts of his own person in regard to his property; (2) the acts of his neighbours in regard

9. Recommendations of Fire Prevention and Insurance Committee of Philadelphia Chamber of Commerce, pp.6-7

to their properties; and (3) the work of the municipality in which his property is located.

That this is true may be demonstrated by studying the problems of the insurance rate-maker. Among other things, the rater must take into consideration every detail that has a bearing on¹⁰ (a) the probability of a fire occurring, (b) the probability of such fire spreading, (c) the probability of its being extinguished, (d) the probability of damage by fire, smoke and water and (e) the probability of a communicated fire.

A practical application of these principles is shown in various rating schedules. Mr. F.C. Moore, founder of the "Universal Mercantile Schedule", and pioneer in the work of schedule rating, based his method on the following logical order:

1. Fixing a basis rate for a standard building in a standard city;
2. Additions to and deductions from the basis rate for bad points and good points respectively in given city with standard building;
3. Additions and, or deductions for variations in construction of given building from standard building;
4. Addition for the occupancy hazard;
5. Deductions for fire appliances in building;
6. Additions for exposure hazard;
7. Deductions for fire protective devices, as automatic sprinklers;
8. Addition for adverse legislation;
9. Additions for faults of management, easily corrected.
10. Final rate

10. C.M. Goddard: Fire Insurance Rates in the Making by the National Board of Fire Underwriters, p.8

It is immaterial what criticisms have been advanced against schedule rating. The passing of time may find a good substitute in experience rating. Nevertheless, the fundamentals underlying any system will and should remain the same. In the first place, the fire tax varies in direct proportion with fire losses. Secondly it varies in strict relationship with the hazards involved.

This being so, the effect upon the individual property owner is highly educative. His interest is enlisted in the program of fire prevention, and further than that, in actually improving his risk. The latter is accomplished in at least three directions:

(a) It arouses the individual's volition in bringing about improvements on the construction and occupancy of his own building and in the purchase, followed by proper maintenance, of adequate fire protective devices.

(b) In order to mitigate the exposure hazard, the individual is indirectly spurred to urge his neighbours to better their risks. Should his neighbour be a nuisance, he would not hesitate in telling him so but would persist until he has succeeded in his attempt to right the "unneighbourly act" which had been done upon him.

(c) By exercising his right as a citizen un-

der a democratic sun, the individual will do his best in urging his state and country to pass various laws and ordinances designed to curtail fire losses and also to establish various departments in connection with the problem of fire fighting.

By way of showing the dynamic force the operation of these rating schedules possesses in reducing the fire waste, it may be well to note¹¹ that in the territory of one rating organization which embraces the larger portion of the State of Pennsylvania and some adjacent territory about 40,000 reductions in rates for actual improvements in risks or removals of hazards made under schedule were made during the year 1922. Figures in the City of New York alone show that in the same year over 80,000 applications of schedules were made largely for the purpose of securing reductions in rates through decreases in fire hazards.

(6) Co-operative Effort.- The importance of co-operative effort in fire prevention cannot be over-emphasized. Organized effort, initiated and perpetuated by various fire prevention bureaus and organizations, can go a long way in materially preventing and reducing fire losses. If such organizations are well supported

11. R.M.Bissell: "Insurance and Fire Prevention", 1924 Convention Year Book on Fire, Casualty and Surety, p. 169

financially, if they possess a staff of experts who really know the business of fire prevention so as to make it a reality instead of a fiction, and if they are backed by the moral and active support of the large class of property owners as well as of the government, there is no telling of their ultimate success in the field of fire prevention.

The story of co-operative effort in the direction of fire prevention in the United States is a long one. It brings one back immediately to the various organizations of underwriters who, as the system of insurance so dictates, are the ones that are directly as well as immediately effected by the "burning question". Such organizations, according to the classification of Dr. Riegel, may be local, sectional or national in character,¹² and their services, as enumerated by Dr. S.S. Huebner,¹³ are multifarious. But their chief work with which we are concerned at present is the reduction of the fire waste. They seek to accomplish this by strictly adhering to the different factors of fire prevention we have mentioned so far and also to the inspection of properties and fire protective devices, the support and maintenance of fire departments in certain places, and other factors related to fighting fire it-

12. R.Riegel: Fire Underwriters' Associations in the United States, 1916.

13. S.S.Huebner: Property Insurance, pp.281-287

self.

Outside of these underwriters' organizations, there are numerous local and national societies which are also interested in the problem. They are either actuated by a direct or indirect concern, or moved by a laudable spirit of service, patriotism, philanthropy, or humanitarianism. It is probable that most of these live up to their expectations and constitute a blessing to the communities in which they are located. At the same time the chances are also probably even that a large number of them are idle organizations, - those that meet once or twice, perhaps never, in a whole year and pronounce their work accomplished after having distributed a few circulars.

However, there are quite a few organizations which, by virtue of their outstanding work in the past, have forced themselves upon public attention. We are referring particularly to (1) The National Board of Fire Underwriters; (2) The National Fire Protection Association; (3) The Underwriters' Laboratories; and (4) the Chambers of Commerce of various localities.

(1) The National Board of Fire Underwriters.-

It is true that this versatile organization, the National Board of Fire Underwriters, has always been engaged in various lines of work of importance other

than fire prevention. Its numerous committees are daily engrossed in problems of deep import like the standardization of rates, supervision of brokers and agents, uniform practices and forms, economy in the conduct of business and improvement in legislation. Fire Prevention comes along as only one of these services. But the early history of this organization, as narrated most ably by Mr. Brearly in his book on "Fifty Years of Civilizing Force", was a gripping tale of a bitter struggle against fire waste. If a curve is plotted of the fluctuations of fire losses in early years and another of the growth of the organization with its alternate periods of slumber and activity, one would find an excellent instance of direct correlation. In other words, old time underwriters, in time of peace and prosperity when they were little molested by costly fires, were wont to unite against the menace of cut-throat competition. But as one conflagration followed another and emptied their treasury until the last cent of profit had gone, they then became alive to the seriousness of the burning question, and it was in such periods that the Underwriters' Association showed signs of periodic activity.

And so as the years rolled by with the fire situation assuming a more and more alarming aspect, the

National Board crept into eminence step by step. In addition to performing its other ^{and} functions, the Board has become a powerful national force in fire prevention. It has a score of committees each of which is entrusted with a separate duty. There are committees on publicity, inspection, causes of fires, building codes, arson and incendiarism, statistics, etc. Their work has been characterized as highly constructive and is indeed so in view of the numerous accomplishments that have been achieved.

The Board is also largely responsible in bringing into existence and partly supporting two other gigantic institutions. They are the National Fire Protection Association with its central office in Boston and the Underwriters' Laboratories in Chicago. These will be discussed in their respective order.

(2) The National Fire Protection Association.-

This is an organization composed of fire insurance engineers and national or local organizations and associations interested in fire prevention. In its membership list are printed names of over 130 organizations. Its chief functions as enumerated in a booklet it published¹⁴ are (1) to make the standards under guidance of which the fire waste may be checked and (2) to educate the people in the observance of these standards and

14. Story of the National Fire Protection Association and Its Publications, p.3

point out the grievous economic penalties for ignoring them. As such its activities are technical as well as educational. Technically, the association, through the work of its staff of expert engineers who serve without pay, is engaged in compiling and establishing standards and in revising such standards from time to time as the progress of the nation in science, invention and industrial arts, so demands. These standards are officially adopted by the National Board of Fire Underwriters and other organizations in fire prevention. Also, the association is deeply interested in public education. It has published various magazines, posters, pamphlets and booklets the number of which publications exceeds 160 different kinds up to May 1925. As all of these are distributed free or sent at a slight charge for printing expenses, they incurred a large item of expenditure for the association.

(3) The Underwriters' Laboratories.— This organization stands without an equal in the world as "A Symbol of Safety".¹⁵ Behind its dignified but unassuming front in Chicago, science is waging the war of Civilization with Fire. Here fires are fought before they start, and the attempt is made to prevent the creation of hazards. This is accomplished by the following few

15. Mr. H.C.Brearley, in his work entitled "A Symbol of Safety", describes in a very excellent manner the work of the Underwriters' Laboratories and what it has done in the direction of fire prevention.

of its more important activities:

(a) Every known device for fighting fires is tested and standardized here. The work includes fire extinguishers of all descriptions, each one of them being carefully studied from the standpoint of mechanical efficiency and usefulness.

(b) The organization also aims at the up-building of standards for fire prevention. Fire doors are tested; insulating materials for use in electrical construction and equipment, special fire hazards inherent in manufacturing processes, fire retardants as wire glass windows, etc., are all studied carefully and standardized.

(c) Articles of daily use are closely scrutinized from the fire hazard standpoint. An inspection system is maintained in hundreds of factories which produce goods directly or indirectly concerned with fire prevention. Safety matches, for instance, are tested. Gas pipes, cooking utensils, articles pertaining to the kitchenettes, and other articles of common use are closely examined with regard to their possibility of setting fire to their surroundings. Such articles, after they have passed thorough tests and shown their worth, are labelled with the approval of the Laboratories, - a sign of safety.

The plant is at present located in Chicago and is supplemented by about seventy-seven other offices in the United States, six in Canadian cities and one in London. It was incorporated in November 1901, but, as it advertised and has always lived up to its advertisement, it is an institution "for service and not for profit".

(4) Chambers of Commerce.- In the formation of fire prevention committees of Chambers of Commerce in different localities, recognition is made of the fact, as pointed out by Mr. Eliot H. Goodwin,¹⁶ Honorary Chairman, National Fire Waste Council, that fire waste, while it is a problem affecting the entire country, is different from other national problems in that it must be treated locally. Different communities have different fire hazards. Manifestly, from the standpoint of fire hazards New York is different from San Francisco, just as Chicago differs from Miami. This being so, Chambers of Commerce are the most fitting organizations in attending to the fire questions of their respective localities. Thus in practically all the important cities where chambers of commerce have been organized, the fire prevention problems of the districts are left to the discretion of specially organized committees of

16. Fire Prevention Committees of Chambers of Commerce, booklet prepared by the National Fire Waste Council, Washington, D.C., p.1

fire prevention and insurance. In large cities, sub-committees on educational work, laws and ordinances, publicity, structural and protective installations, also come into existence with the common end of protecting their respective communities from the devastating effects of fire.

CHAPTER IV
FIRE PREVENTION - FIGHTING
THE FIRE ITSELF

In the last analysis, fire prevention has, as its chief objective, the complete smothering of the possibility of fires. While this is very laudable, the world at large has not yet progressed far enough in scientific knowledge to permit its realization. Fire is characterized by its universal latency; it may break out any time and ^{at} any place. The only rational thing to do, therefore, is to be prepared, so to speak, for the worst, for the occasional appearance of a fire in spite of all precautions, and to devise and install appliances, mechanical and engineering, of such a function as to detect, arrest, and smother a fire in its incipency.

Fighting the fire once it is started may be divided into at least three distinct^t stages, namely: (1) Detection of the fire and signalling an alarm; (2) fighting the fire from within with ordinary fire devices as water or sand pails, chemical extinguishers, automatic sprinklers, etc. and (3) combatting the flames with extraneous aid as from an organized fire department.

(1) Detecting A Fire and Signalling Its Appearance.- Under this heading we may distinguish between two different types of systems: (a) that which operates with co-operation of the human mind and (b) that which operates automatically, without human assistance.

In the good old days when automatic fire alarms were unknown, the human element was depended upon to a very large extent for the detection of fires and sending out of alarms. Thus, an occupant, discovering a fire in his occupancy or in some other construction within his limited vision, would probably employ all the physical means in his command to impart this knowledge to others. He might sound a horn, a whistle, or create noises with other noise-making instruments. He might even play the part of a hero, and rush into a burning structure to save the lives of perchance of some fair ones. If the observer were a woman, she would, at the sight of a roaring fire, shriek and scream until help was rendered and if a child, it would, likewise, cry. All these, consciously or unconsciously, inevitably provoked alarm, constituting the very mechanism of a human alarm system, - proficient at times and serviceable in many instances in quenching a fire in its first few minutes of destruction.

As an improvement upon this sy^stem which at best is crude to the extreme not to say totally unreliable and positively dangerous, municipalities to-day are installing alarm systems in different parts of their localities. Supplementing these systems, house owners also^o install auxiliary fire alarms inside their buildings. The importance of both of these can scarcely be over-emphasized. In order to save every possible second, the fire department must be notified at the earliest instance so as to reach the precise spot before the fire gets beyond control.

Still, these systems depend to a large extent upon the alertness and the generosity of a casual observer. Legally nobody is compelled to raise an alarm when he sees the presence of a fire. Besides, when no such an individual is present, a fire may develop into serious measures before its existence is known. Hence, someone whose profession it is to watch for fires is employed. And then in view of human limitations, the watchman himself is watched. To do this an expensive method is to maintain a central station system where the watchman may register his rounds, or he may be supplied with a portable time-recording apparatus which follows his rounds automatically.

It is evident that all the methods discussed

so far, depending as they do upon the co-ordination of the human element, are by nature defective. A watchman may displace the shortcomings of a casual observer, but few watchmen are really careful, efficient, intelligent, or mindful of their duty. Granting further that he is a conscientious worker, the system itself has an inherent weakness, for it is manifestly impossible for a watchman to be everywhere at the same time or even to return to one place for more than a brief period of time. This being so, sufficient time may have elapsed between rounds for a fire to gain considerable headway.

Therefore, experience has directed men to the development of alarm systems the operation of which is automatic. Various devices for such automatic transmission are now in use. They are operated either directly by the action of heat upon thermostats or by the passage of water through sprinkler pipes. Thermostats may be of the electric type in which an electric current is closed upon the solder melting through presence of abnormal heat, thereby causing the ringing of gongs or bells at selected points. Another type also makes use of unusual heat, which, however, causes an air pressure or vacuum to be released in a system of pipes connected with an alarm.

Such automatic systems have been of use no doubt. The National Board of Fire Underwriters, upon recommendations from the National Fire Protection Association, has developed elaborate rules and requirements for their installation and subsequent upkeep. This we need not go into here; suffice it to say however that with due respect to the wiring, the gong, the transmitter, etc., chief emphasis must be laid on the construction of the solder head. Its melting point must be carefully calculated in order to avoid an alarm going off at an unwarranted moment or not going off when the crucial time arrives.

(2) Fighting the Fire From Within.-- A fire having been detected and its presence broadcast, we come next to methods aiming at its annihilation during the first five minutes. Prior to the arrival of a fire department, there must be methods, automatic as well as non-automatic, to check its onslaught. Non-automatic fire extinguishing devices may be the following:

(a) Water and Sand Pails.-- This furnishes simple and handy protection. Human instinct almost invariably turns to water pails in case of a fire. Their efficiency is known to women and children. Unfortunately, a chief drawback finds itself in their susceptibility to mis-use for domestic purposes, to evaporation

and foul water. As they are unsightly, they are often left out of strategic points. Furthermore, in time of emergency the water in a pail is supposedly thrown at the fire all at once, leaving thereby no reserve, except more pails when the fire fails to ignite. If the fire is burning under cover, pail protection is at an even greater disadvantage. Some fires as the burning of grease, oil, varnish or benzine increase with rapidity upon addition of water, and to fill the pails with water is dangerous to the uninformed whereas not to do so defeats their very purpose of existence. It is true that in this case sand pails are of course more serviceable, but they too are subject to other difficulties.

(b) Chemical Fire Extinguishers.- In conjunction with pail protection chemical extinguishers are useful where extraneous aid is not needed and where it is desired to eliminate unnecessary water damage. They may be automatic or non-automatic. The latter, in turn, may be either portable or stationary, both of which operate on the same principles. They are put in action by some simple process, and carbonic acid gas is generated, which, by its own pressure, forces a stream of water and gas when directed on the

fire. The surrounding atmosphere being heavily laden with carbonic acid gas, the progress of the fire is retarded, while the cooling effect of water accomplishes the rest.

(c) Standpipe and Hose.- This offers valuable protection in buildings not furnished with an expensive automatic sprinkler system. In making it reliable, at least several things deserve careful attention: (1) there must be a constant supply of water with sufficient pressure; (2) the pipes, valves and hose must be properly installed and maintained and (3) there must be available persons who are mentally as well as physically fit to make use of such facilities. Just as in other equipments, there are rules and requirements fixed by the National Board of Fire Underwriters governing their installation and maintenance.

Reviewing now these several fire fighting facilities, one observes easily a serious drawback. Granting that from the mechanical standpoint such appliances have no defect whatever (which by the way needs to be proved) there is also the human element to consider. They may work successfully under the direction of capable clear-minded individuals, But they offer no assurance that this would always be the case.

In fact few individuals, unaccustomed and untrained, do not lose their heads under the strain of a fire. A standpipe and hose may offset to some extent the temporary character of the service given by water pails and fire extinguishers; yet it is doubtful whether the individual using it is equal to the occasion, not to say whether he (or she), without the necessary experience of a trained fire fighter, has the required physical strength and endurance to handle the hose with its enormous water pressure.

Some automatic appliances, therefore, must be devised to overcome these difficulties. Under this topic we may mention the automatic chemical fire extinguisher and, more particularly, the versatile water sprinkler system.

Essentially the principles underlying both devices are similar. The chief point of difference, of course, lies in the fact that where the sprinkler system distributes water, the chemical extinguisher gives out carbonic acid gas. The latter is as yet of recent inception and has not been sufficiently employed to demonstrate its general usefulness. Nevertheless, it has a clear advantage over its sister invention, namely, that it obviates water damage, which, in the case of a sprinkler system, often amounts to an alarming total. This peculiar virtue renders it particularly

adaptable to risks which contain stocks of a water-damageable nature and also to use on shipboard where its installation adds but little weight to the tonnage and, as it displaces the use of water, eliminates the necessity of pumping hundreds of tons of water into the ship and thus reducing the vessel's buoyancy.

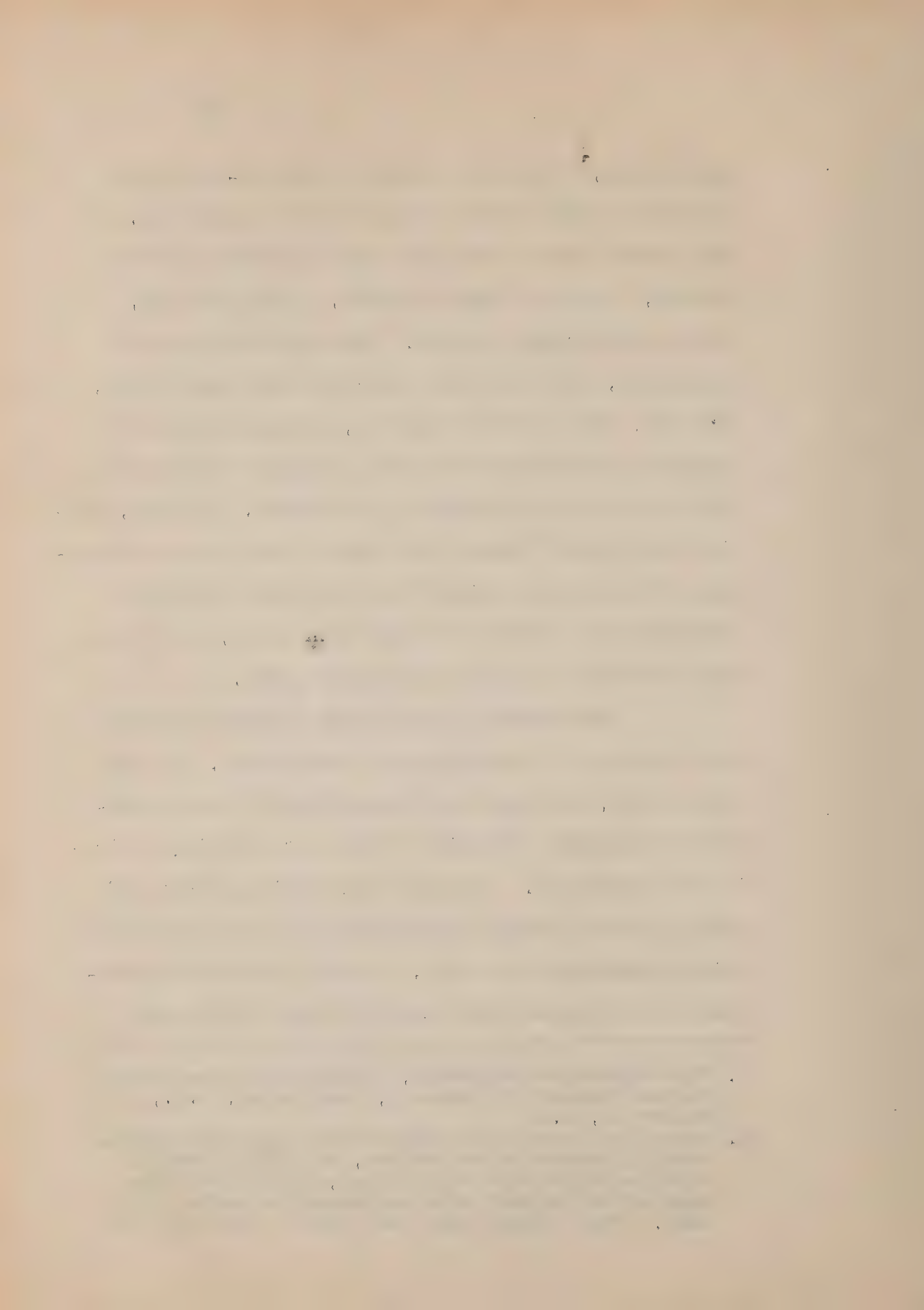
But the sprinkler system has been more commonly used and in most cases is given the preference to other systems. Its adoption is especially apparent in large cities with what is known as conflagration areas. Take a city like Philadelphia for instance. Here the entire congested district is literally "sprinklered", where one cannot fail to notice huge water reservoirs towering over the roofs of practically all the large buildings.

Two factors are largely responsible for its wide application. First, a "sprinklered risk" is considered to be a good risk by fire underwriters, which is more or less the result of the second factor, namely, that the sprinkler system has an established prestige. The first is evidenced by the fact that, according to the rating schedules, the rate is slashed more than half for a risk that is sprinklered. The second may be proven by a little statistics. Citing the figures compiled by the National Fire Protection

Association,¹ within a period of twenty-six years there were 28814 fires in sprinklered properties. Of this number 19007 fires were extinguished and 8583 checked, giving a total of 27590, or 95 per cent, under satisfactory control. The meagre balance of 5 per cent, which was not satisfactorily controlled, embraced, upon careful analysis, a huge element of improper maintenance which was probably responsible for at least three-fourths of the whole. Further, earlier statistics² showed that only a very small percentage of "sprinklered fires" ever reached sufficient proportions to warrant a claim being made, and even in such cases the claim was unusually small.

The success of the water sprinkler system in fire fighting is due mainly to two reasons. In the first place, the peculiar composition of the sprinkler head enables detecting as well as fighting a fire in its incipency. Secondly the cooling effects of running water greatly annihilate the chance of a fire being communicated by heat. A study of the construction of the system will bear out these two points

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1. Fire Prevention Bulletin, published by the United States Chamber of Commerce, Washington, D.C., Number 10, p.2
 2. According to the bulletin of one leading manufacturing automatic sprinklers, of 22827 fires in risks equipped with sprinklers, only 7224 fires were of sufficient size to warrant a claim being made. The average loss per fire in these sprink-



clearly. The equipment consists of a system of pipes with vertical feeders called risers, connected near each ceiling to horizontal feeders which supply the sprinklers on that ceiling. Water is furnished from elevated tanks or by underground pipes leading from a private stationary pump. The sprinkler head, however, is the object deserving chief consideration. It is a nozzle made of composition metal normally held pressure tight by parts which are retained by an especially-compounded, low-fusing solder which melts and releases the parts under the influence of undue heat, thus releasing water through the sprinklers to areas restricted by a deflector mounted over such orifice.

Thus if a fire breaks out in a sprinklered area, its presence will be detected at once, and before it can gain much headway, water will have reached the precise spot to give it an untimely death. In addition to quenching the actual flames, the system does a second important function. It alleviates the deadly effects of heat on nearly ^{or} properties which may be of an easily burnable, if not explosive, nature.

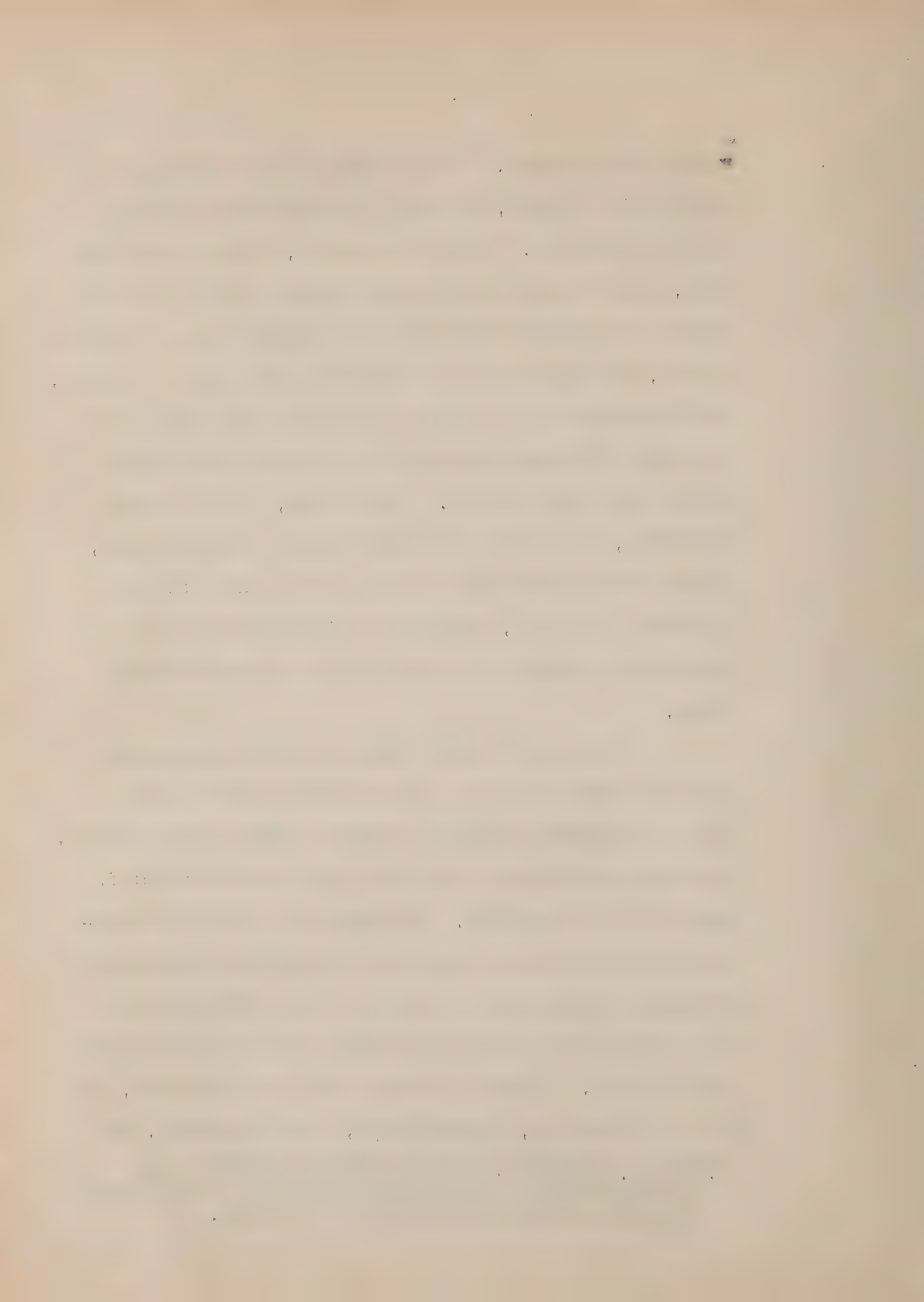
This second function is particularly adapted to the protection of a building from outside exposure. The necessity of such protection is evident from nu-

lered risks was only \$315 as compared with an average loss of \$7361 per fire paid by the New England Mutual Insurance companies prior to the introduction of sprinklered protection. - (S.S.Huebner, Property Insurance, p.305)

merous experiences. In the Burlington Building fire of 1922 in Chicago, the conflagration was a totally communicated one. In this instance, fire or radiated heat, leaped fully eighty feet across air and space to enter the building and cause the destruction of several floors, exacting a toll of several millions of dollars. Yet by means of an external sprinkler protecting the building on ^{ex}posed sides such a communicated hazard could have been avoided. This sytem, the external sprinkler, furnishes a flowing sheet of water which, coupled with other facilities as wire glass windows and metal barriers, presents an impenetrable wall against the inroad of flames or heat from adjoining fires.

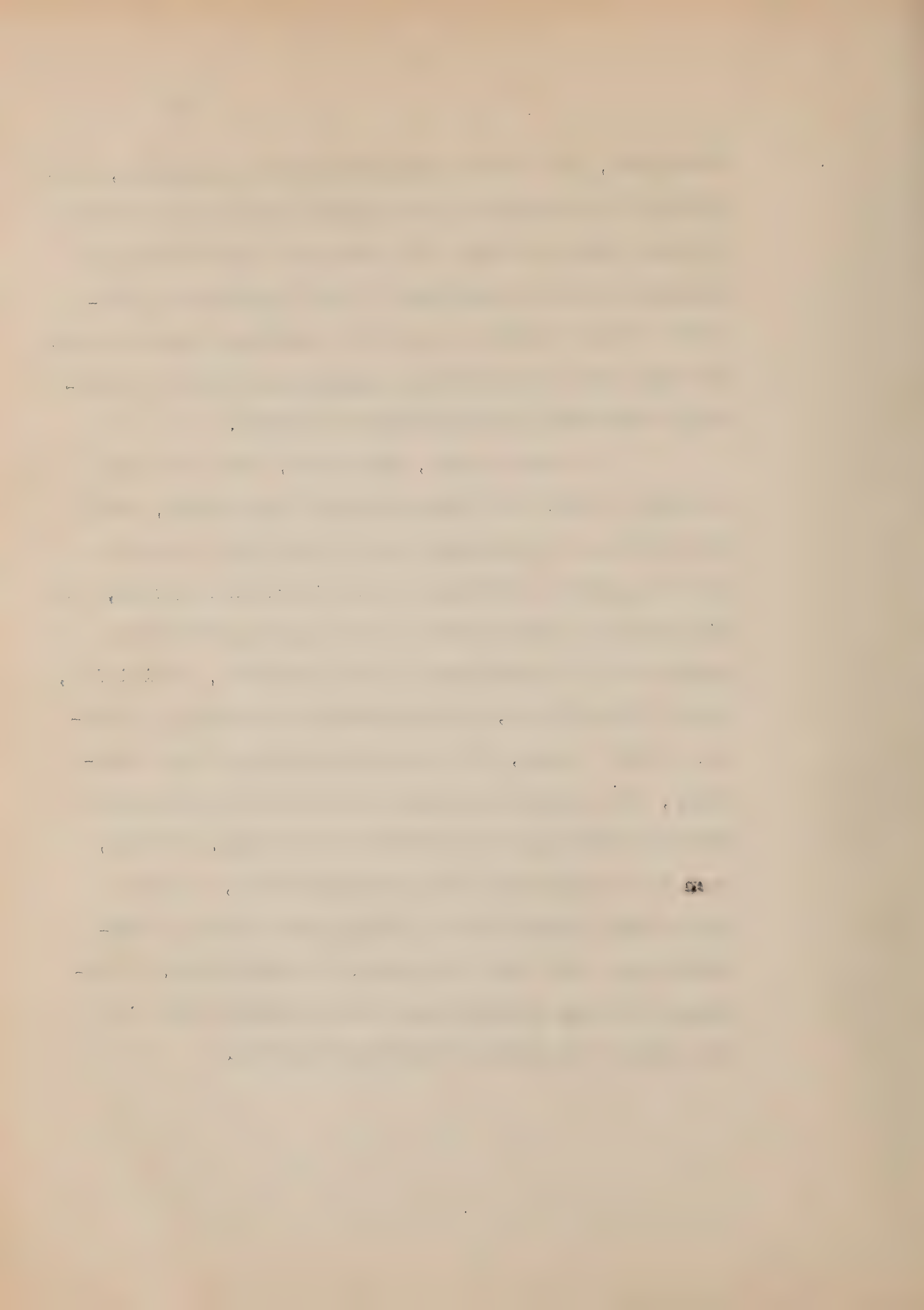
There is little doubt that the importance of water sprinklers has established itself in the minds of ordinary laymen as well as legislative bodies. Sprinkler legislation has now come into existence in many states in America. According to the report compiled by the National Automatic Sprinkler Association of America there are at present about 138 different city ordinances and 12 state laws governing sprinkler installation.³ Some of these state requirements, as those of New York, Pennsylvania, Massachusettes, and

3. Ira G. Hoagland: Sprinkler Legislation in the United States, pamphlet published by the National Fire Protection Association of America.



Wisconsin, are fairly comprehensive in character, containing laws requiring sprinkler installations (1) in theatre stage sections (2) providing that their use permits liberal extensions of the floor area allowances of the building codes (3) requiring them in mercantile and manufacturing basements and (4) in buildings considered "conflagration breeders."

It may be said, therefore, that with the adoption of more of these healthy regulations, with the growing consciousness on the part of the public of the general usefulness of the sprinkler system, and with further advancement in the improvement of the mechanism and operations of the sprinkler, minimizing, as an illustration, all unnecessary as well as necessary water damage, the water sprinkler and its auxiliary, the external curtain sprinkler, will accomplish much in reducing fire losses to a minimum. Indeed, even at its present stage of development, one may agree with various writers and without fear of contradiction that this invention, the sprinkler, is already the best contribution that has ever been made to solving the vexing fire waste problem.



CHAPTER V

FIRE PREVENTION - FIGHTING THE FIRE ITSELF (CONTINUED)

Fighting Fires With Extraneous Aid.-- Thus far we have limited our discussion to methods of fighting fires without extraneous aid in the hope that a blaze will be put out during the first few minutes. It may be reasonable^y expected of course that improvements in this direction of fighting fires internally should be included in any program of fire protection that can be called comprehensive. However, it is not safe, and positively dangerous, to assume that all buildings are equipped with up-to-date fire protective devices or that, if so equipped, such devices will ~~always~~ be manned to the fullest satisfaction. Granting that both assumptions were correct, it would still remain possible for a fire to develop into menacing measures and thus necessitate external aid. No city, therefore, can be reasonably safe from the standpoint of fire prevention without an organized fire department which can be relied upon on all occasions.

For this reason numerous cities have established fire departments on an elaborate scale. Modern equipments are installed apparently without regard to

cost. In Philadelphia alone expenditure in this direction amounted to over half a billion dollars annually during the last few years.¹ Her fire department has a total membership force equal to the population of a small city, the number in 1924 being only a little below 2,000². Of these about three-fourths were paid full-time workers. New York, with all its boroughs and a small fire area although a larger population, has a trained force of some 6,664 firemen spreading throughout the metropolis the majority of whom, except 658 volunteers are paid full time workers.

It is true that villages and cities with a scanty population cannot be expected to possess organizations of such magnitude. In most cases, they are protected by departments organized on a minor scale, with ordinary equipments and usually employing a paid fire chief who attends to the general welfare of his district and has under him a trained force of volunteers. If other better equipped departments, from neighbouring districts are available for use in case of a conflagration, such simple protection is ample.

1. See chapter 1, Fire and the Losses of Fire

2. Insurance Year Book, Fire and Marine, 1924, p.C230

In the case of huge business establishments situated in far-off sub-urban districts and ^{de}void of the immediate services of a public fire department, it has also been found advisable to organize private departments of their own. A department of this nature is useful in promptly extinguishing a fire or at least keeping it under control before the arrival of outside help. It can be maintained with comparative ease among the employees, and should work with efficiency if the project is supported whole-heartedly by those in control. Its success can be further assured if care and discrimination are exercised in selecting the personnel, and money generously but rationally spent for equipments necessary to effective work. Other problems connected with a department of this nature are more or less akin to those that confront a public department and that will be discussed below.

Organization of A Fire Department.- The problems relating to the organization of a fire department are numerous. Its functions are also manifold. Both of them differ with different localities and circumstances, and it is doubtful whether a department adapted to the needs of one city would be thoroughly satisfactory to meet the requirements of any other city.

Bearing this in mind, we may proceed to outline the problems as follows:

(a) Financial Support. Of the utmost importance to an organization as a fire ^{de}partment is the question of finance. Without a strong financial backbone, it is manifestly impossible to combat against the deadly menace of fire. For one thing, the equipment would be seriously handicapped, and if modern efficiency demands a "flying squadron", how is it ever possible to fill the need with an old vehicle drawn by an age-worn horse? Further than that, with an uncertain financial status, the firemen themselves will most probably be part-paid, half-paid, and under-paid; and this, without the least shade of doubt, spells inefficiency and disaster.

Therefore, in view of this importance and knowing that a fire department is for the people, by the people, and of the people, the logical ^sconclusion follows that appropriations must be made on the people to cover all necessary expenditures. Such appropriations must be sufficiently generous to allow not only for immediate spending but also for expansion in the future. Thus for years New York and Chicago have appropriated from about one dollar per capita to nearly double that amount, while Philadelphia, Boston, Buffa-

lo, Detroit, and other progressive cities have levied annual exactions ranging from \$2.00 to \$2.50. Unfortunately a review of smaller towns and villages shows a radical departure from this practice. In these numerous townships, the allotments allowed for fire department expenditures fluctuate widely, but the majority give only a little more than fifty cents per capita. To this niggardness may be attributed the disastrous fires of many small cities and towns in the past and present.

Undoubtedly this problem of raising money is vexatious. But it may be solved in a number of ways.³ The appropriations may come direct from the state treasury; or the treasurer, with the stamp of municipal authority, may collect from door to door; insurance companies, also, may utilize a part of their premiums in support of a venture of this nature; and lastly the whole plan can be made much more grossly interesting and attractive by the giving of fairs, masquerades, balls, luncheons, and other occasions of merriment.

(b) Selecting the Department Force.- It is obvious that there must be a strong and efficient fire

3. Methods of Financing Fire Departments, the "American City" magazine, May, 1925.

force composed of men chosen with the greatest care and discrimination. They must be of known reliability, intelligence, courage, physical strength and presence of mind, and when chosen must be constantly drilled to be at their best. After all, fire fighting is a dangerous calling and there is no telling what may happen in the course of battling against flames and smoke and of rescuing the entrapped among heated structurals and burning timbers. Therefore, in the selection of men, preference must be given to those who have interpreted their profession from the correct standpoint: that it must be taken with the bitter pill of sacrifice.

This does not mean, however, that all firemen must work gratuitously, or that they need only be part-paid and possibly underpaid. On the contrary, experience has told us that, while the majority of fire fighters in this country are enlisted on the volunteer basis, their work has been "more enthusiastic than efficient."⁴ There have been repeated discussions on the respective merits of a salaried staff and a volunteer company. Excellent arguments have been advanced on both sides, but surely the man who is substantially paid for his work can perform his duties better and

4. G.S.Curtis: chapter on Public Fire Departments, in Crosby-Fiske's Handbook of Fire Protection, p.139

at least more thoroughly than another who works gratis and who consequently is engrossed in personal matters, necessitating his absence at times when his presence is most needed.

At the same time, it must be admitted that although this practice of employing paid workers is perfectly feasible in cities of considerable size, it will work tremendous hardship if brought to bear on small towns and villagers with scanty populations. Evidently in this case the volunteer has his place. With him may be introduced part-time workers who, under the command of a full-paid fire chief who spends his entire time studying his district, will form a very valuable unit in the protection of a community below, let us say, 10,000 people in size.

(c) Equipment. Alongside with a strong human force, the equipment deserves special attention. No fireman, as a human being, can work barehanded, but as in other trades, his efficiency increases with increasing efficiency in his tools. To insure that only the correct kinds of equipment need be purchased, emphasis must be placed on⁵ (1) the topography of the city; (2) the character of the buildings to be pro-

5. Crosby-Fiske: Handbook of Fire Protection, p.141

tected; and (3) the character of the water supply. Without going deep into each one of these factors, it can be shown readily that where New York requires more than half a dozen water towers to safeguard her innumerable skyscrapers, a sub-urban town with few of her buildings exceeding two-stories in height will require no protection of this kind whatever.

We shall not attempt to discuss one by one the numberless fire department appliances that are known to mankind. Scientific progress is bringing us fact² to face with new inventions every day. For our purpose we need only study just what kinds of apparatus there are in the possession of a modern fire department like that, for instance, of New York City. Here, due to the frequency of calls which averaged thirty to forty times a day and the diversity of the character of its buildings ranging from gigantic structures that are so-called fire-proof to small tinder-box wooden tenement dwellings in certain parts of the city, the department has been most generously supported and has developed into one of the strongest - if not, indeed, the strongest - fire forces in the world. Consequently its equipment exemplifies the latest developments along that line and it is not out of place to mention just what kinds of apparatus it has in its pos-

session. According to the examination of the National Board of Fire Underwriters,⁶ its entire equipment in the year 1924 was as the following:

123 auto steamers; 6 auto water towers; 3 auto boat tender; 7 auto high pressure hose wagons; 90 auto hose wagons; 39 auto combination chemical and hose wagons; 35 auto hook and ladder trucks; 84 auto runabouts and touring cars; 55 hose wagons; 7 hook and ladder trucks; 1 chemical engine; 1 searchlight engine; 101 hook and ladder aerial trucks; 7 hook and ladder horse drawn aerial trucks; 2 rescue autos, 201 motor engines; 35 engine, horse drawn, 1; full wagon; 4 full autos; 87 chief cars; 9 fire brats; 125 horses; hose, cotton rubber lined, $1\frac{1}{2}$ to $3\frac{1}{2}$ inches, 321,250 feet; fire alarms: Gamewell, 3534; street bx. of all kinds, including pneumatic and automatic, 5362; department in charge of a commissioner; total member, 6665, paid full time 6007; vol. 658.

(d) The Water Supply. The importance of an adequate and reliable supply of water cannot be over-looked. Water is chiefly depended upon for the extinguishment of a fire, and should the water supply be mutilated or otherwise rendered insufficient in the face of a conflagration, the result would be disastrous. In this respect the San Francisco fire has taught America a costly lesson, being largely attributable to the mutilation of her water system by the earthquake prior to the burning and also to the lack of foresight on the part of those concerned in not

6. Spectator Co: Insurance Year Book, Fire and Marine, 1924, p.C-174

previously safeguarding and conserving a dependable supply of water.

To a large extent, public water supplies are primarily intended for domestic services. This has serious drawbacks, for in the event of a fire, the supply of water is not only inadequate, but sometimes grossly uncertain. In order to overcome this defect, an easy way is to increase the domestic system well beyond the needs of domestic services^c so as to provide for the contingent drafting in time of fire; but a much better method is to install separate sets of mains commonly known as High Pressure Fire Lines to be used exclusively by and under the careful supervision of the public fire department. Even with this improvement, it is always unwise to depend for protective purposes upon only a single independent source of water supply. Experience in the past has pointed to the necessity of having in readiness more than one whenever possible.

Functions of A Fire Department.- The more outstanding problems of organization having been briefly stated, we come to a discussion of the chief functions of a fire department. They are as the following:

(a) Rapid Response to A Call. Nothing is more important than to rapidly respond to a call and to

reach the scene of a fire at the earliest possible moment. Inability to do this is costly, since a fire can be easily arrested in the first few minutes. Modern equipments as the automobiles have made this possible. With proper training and drill on the part of the firemen themselves and adequate maintenance of the equipments, efficiency in this respect can be easily assured.

(b) Inspection Work. Other than actually combatting a fire, a department may best make use of its spare time in systematic inspection work.. Obviously a fire in a modern loft building would be fought differently from an outbreak in an old type of structure with open elevator shafts and stair wells. By inspection work, fire fighters can come to know the construction of practically every building and thus develop a system of handling fires in different types of construction.

But to speak of inspection only in this sense would be inappropriate. Among his multifarious duties, the fire marshal is concerned with every small detail that has a fire hazard. He is concerned, for instance, with the strict observance of fire safety codes in places of public amusement, and with the mitigation of fire hazards in fire-safe construction.

He must be constantly on the lookout for causes of fires, not only to check incendiary burning but also to establish a basis for later reference to facilitate more effective fire-fighting.

(c) Salvage Work. Strictly speaking, salvage work cannot be considered as one of the chief functions expected of a fire department. In most large cities at present, there has come into existence a class of professional salvage workers who are under the employment of insurance companies and whose sole duty it is to save the stock and furniture of a burning compartment. It may be argued nevertheless, that fire fighters, in the absence of other prevalent perils and having in mind the general economic good of society at large, may take active part in a work of this kind, as, indeed, removing the stock is cutting off the fuel of a fire and as such may be considered as a distinct step to fire extinguishment. Furthermore, a thoughtful fire force, while not actually engaged in salvaging the stock in time of burning, can facilitate subsequent salvage work to a large extent by carefully regulating the use of water and thus obviating unnecessary water damage.

(d) Miscellaneous Functions. In addition to the foregoing there are also a number of other func-

tions. The more important ones that may be entered in this category pertain to the problem of dealing with the work of professional fire bugs, that of adjusting and supervising the water supply, and the standardization of equipments in different localities. The importance of the last must be adequately stressed as it permits the interchange of services in time of emergency.

CHAPTER VI
FIRE PREVENTION - A SUCCESS
OR A FAILURE ?

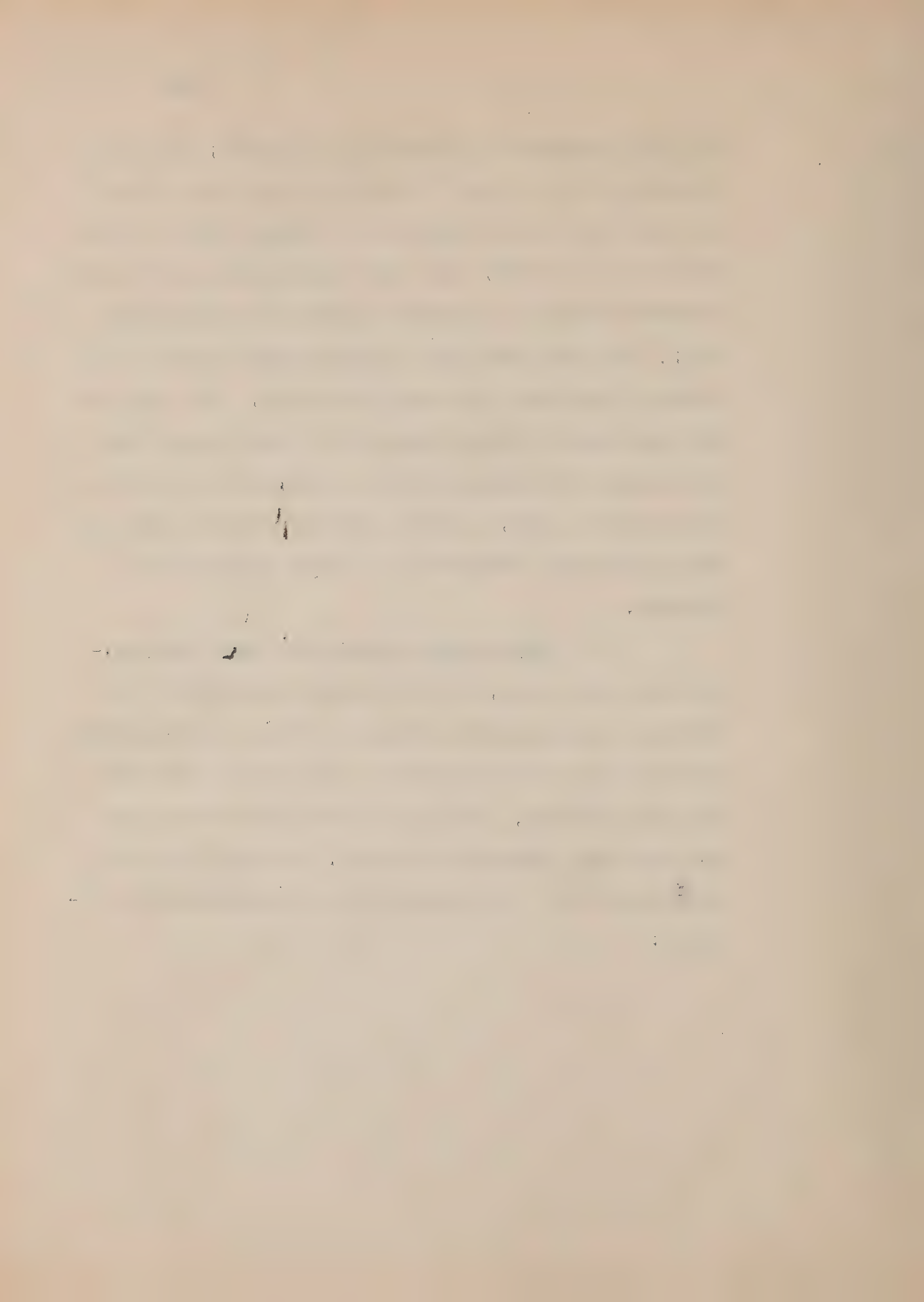
In a previous chapter it was shown how the yearly fire losses in America have been steadily advancing and how also the per capita loss has been an annually increasing one. Facing these painful facts, the conclusion seems to indicate that inspite of the millions of dollars that have gone into fire prevention and the untold amount of labour that has been spent in this direction, fire prevention is nothing less than a failure. Why bother further, comes the lament, with a money-wasting scheme that has an uncertain value and is of apparent futility?

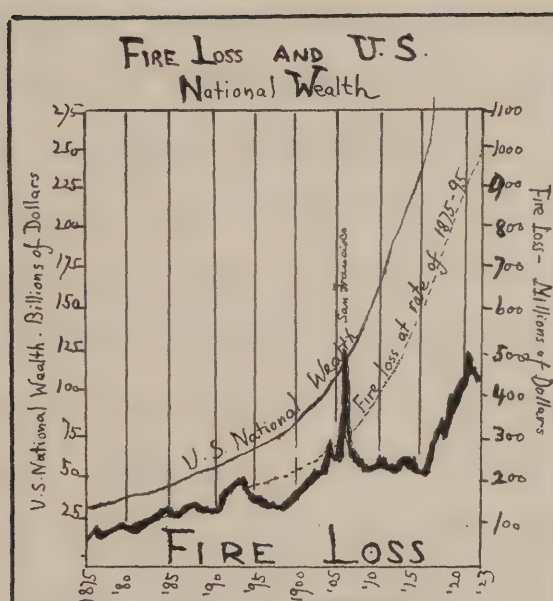
Yet a conclusion of this sort would be unforuntate. The critic, in his zeal to assail fire prevention, has forgotten the practical benefits that have been wrought by protection work. It may be very well to boost of the seriousness of the fire waste problem, but, underneath all, there is no real occasion for alarm. Let us review a few arguments to corroborate this statment: that fire prevention, far be it from a failure, has been a boon. I have reference to these observations, viz.: (1) without fire prevention work the fire waste each year would have been vastly great-

er than indicated by present day figures; (2) the increase in the value of property destroyed is not so rapid as the increase in the total value of destructible property; (3) the burning ratio of insured property value to insurance losses is a decreasing one; (4) fire insurance rates decrease whereas the ratio of premiums to losses increases; (5) absolute and per capita representations of fire losses are misleading in judging relative increase or decrease from year to year; and (6) fire prevention work has been positively successful in other countries in general.

(1) Fire Losses Might Have Been Greater.--

In the first place, it is clearly demonstrable that without fire prevention work or with it half-heartedly attended to as in the case of the last few decades of the past century, the yearly fire losses would have assumed truly appalling figures. Let us divert our attention for a few moments to the accompanying diagram¹:





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1. Chart originally prepared by the National Board of Fire Underwriters, appearing in the "American City" magazine, August 1922.

It may be observed at once that with fire prevention work unattended to as it was prior to 1895, the fire loss curve followed closely that representing the advancing national wealth of the United States. Fortunately as one conflagration after another told heavily on the already meagre treasury of the underwriters, arousing thereby deeper concern in the fire waste problem, the fire curve slowly but surely departed from its former wayward trend. It is true that occasionally are found peaks here and there, as those of the Baltimore and San Francisco fires in 1904 and 1906 respectively, exploring into regions hitherto unknown, but the general trend is without doubt a healthy one and exemplifies the value of fire prevention work as a whole. Were the loss curve to follow the former trend that is, that from 1875 to 1895, the loss in 1923 would have been as great as one billion dollars and that in the past year 1925-1926 would have been even more startling. As it is, the savings from 1895-1923 amounted to a total of approximately \$4,330,000,000², and interest return, pure and simple on fire prevention investment.

(2) Burning Ratio of Property Lost to Total

Destructible Property A Decreasing One.-- It may be argued from the chart given that the national wealth of the United States is composed mostly of intangible property and as only tangible and destructible properties are susceptible to flames, the fire loss curve is a misrepresentation. Admitting that this contention is valid to some extent, figures, however, from the latter source still corroborate our conclusion. An excellent illustration may be had in the comparison of building statistics to fire losses. In 1914 new building statistics were reported at 463 millions and in 1923, 2059 millions, - an increase of fully 444 per cent. Fire losses for the same years were registered at 221 and 535 millions respectively, an increase of only 242 per cent.

Table VII

COMPARISON OF FIRE LOSSES
TO BUILDING STATISTICS

	1914	1923	Per Cent Increase
New Buildings	\$463,000,000	\$2059,000*	444
Fire Losses	221,000,000	535,000*	242

* 000 omitted.

But this comparison has not yet told the

entire story. We have neglected to mention the yearly accumulation of buildings already in existence which were previously saved from fires and which are nevertheless still exposed to the hazard. Their inclusion would greatly increase the figure for 1923 and thus vastly widen the difference. Besides, we must consider further the tremendous increase in the quantity of furnitures that have been accumulated from year to year, the amount of goods finished, raw, as well as in the making, the size and value of crops during the last ten years, and, in short, all other things entering into the category of destructible property. If such an exhaustive investigation could be completed, what result would it indicate other than that the burning ratio of destroyed property to destructible property has been a decreasing one?

(3) The Burning Ratio of Property Destroyed to Property Insured A Decreasing One.— Other statistics also tend to verify our conclusion. According to the combined records of all kinds of insurance companies,³ the amount of insurance carried upon destructible property has increased 155 per cent during a period of ten years. The increase in the annual loss payments has been only 100 per cent. The difference of 55 per cent,

3. R.M.Bissell: "Insurance and Fire Prevention, 1924 Convention Year Book, Fire and Casualty, p.174

being the percentage increase in the amount of insurance carried over the increase in loss paid, measures correctly the work of fire prevention.

Further corroborative evidence may be had in the sworn returns of all fire insurance companies to the New York State Insurance Department. In 1913, these companies wrote risks to the total amount of \$47,665,988,000 with losses incurred \$167,744,202, giving a resultant burning ratio of .0035. In 1922, total business written amounted to \$122,502,816,000 and losses paid, \$345,951,143, indicating .0028 as the burning ratio. The only interpretation we can get from these figures is that there has been a reduction of .0007 in the burning ratio, or that the percentage of insured property destroyed by fire has decreased 20 per cent. Other things being equal, are we not justified in saying that even a very conservative estimate as this would place the reduction of fire losses at at least 20 per cent? Such indeed is no small accomplishment.

(4) Decreasing Insurance Cost.— Let us also bear in mind that while the ratio of insured property to fire losses has been decreasing during the past few decades, the ratio of insurance premiums to losses has been steadily going upward. It was reported that

in 1913,⁴ out of a premium of one dollar 52 cents went to the payment of claims, whereas in 1924,⁵ as much as 60.16 cents had to be spent in this direction. Yet inspite of this apparent handicap, the average rate on risks written for one year was at least over 10 per cent⁶ less in 1924 than in 1913. This, of course, may indicate a number of things, as for instance greater certainty with the increase in the volume of business and decreasing cost of operation. But with due respect to other factors, may it not be said that a more tenable explanation is in the saving of the burning ratio of insured property to fire losses, which, in turn, is attributable to more vigilant work in fire prevention?

(5) Fallacious Representation of Absolute Figures and Per Capita Computations.- It is perhaps time now to dispel the fallacious idea as suggested by present day figures that the fire waste problem is growing worse. In the first place it can be easily understood that absolute figures afford no basis for

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4. R.M.Bissell, Insurance and Fire Prevention, 1924 Convention Year Book, Fire and Casualty, p.174
 5. H.A.Smith: Annual Review of Fire Insurance, 1925 Convention Year Book, Fire and Casualty, p.21
 6. Mr. Bissell calculated that the difference between the 1913 average rate and that in 1922 was 11-12%, 1924 Convention Year Book, Fire and Casualty, p.174

comparison. Common sense tells us that in the comparison of two or more things especially when these tend to vary with the passing of time, relative figures are much more suited to the purpose. Statistics may show that in 1913 companies reporting to the New York Insurance Department paid a total loss of approximately 168 million dollars and that in 1922 the loss incurred amounted to 346 millions. This may cause considerable alarm, since in this case the increase in absolute figures is as high as 178 millions, a somewhat appalling figure. However, a little more thought and some labour spent in computation will immediately reveal a situation to the contrary, converting disappointment to joy, for, relatively speaking as has been shown above, the burning ratio of losses paid to insured property was .0035 in 1913 and only .0028 in 1922, a veritable reduction of fully 20 per cent.

The fallacy of representing fire losses in per capita figures is not so apparent, but the fallacy is there nevertheless. The inconsistency is due to the fact that the value of destructible property as well as the actual value of property destroyed by fire has been increasing at a much more rapid rate than the entire population of the United States. Thus the census shows a gain of 15 $\frac{1}{4}$ per cent in population in ten

years, whereas for the same period of time, property values have multiplied at least 150 per cent, or ten times the increase of population.

(6) Fire Prevention Justified by Experience in Other Lands.— America, we are told, has the best fire fighters in the world, men who are well trained, skilled and experienced. In addition, her fire-fighting facilities have been developed to a remarkable degree. The results then which we have shown to be so far successful, may speak well of fire prevention. But if the experience of America alone cannot be taken as conclusive, it may still be said as a general proposition that fire fighting experience in other countries, especially those on the European continent, has been even more favourable. Here the spirit of fire prevention, if its science has not been so well developed as in America, has been better grasped by the people and early incorporated in their building ordinances and civil law codes. So far as figures are available⁷, the loss in American cities in 1913 was \$2.10 per person, while that in France was \$-.49; England, \$0.33; Germany, \$0.28; Italy and Austria, \$0.25; Switzerland, \$0.15; and thrifty little Holland, \$0.11. This comparison carries with it a further conviction other

7. Safeguarding the Home Against Fire, a fire prevention manual for the school children of America, prepared by the National Board of Fire Underwriters, p.8

than the practical benefits of fire prevention, that if such results can be achieved in other lands, why not so in America and the world at large?

CHAPTER VII

THE NEED OF FIRE PREVENTION

Early Historical Need.- Fire Prevention is an institution that dawned with the beginning of man. Primitive people who ate raw meat and found shelter in stone caves were already engrossed in problems of keeping away fire and its effects, heat and smoke, from their humble dwellings. If they had not learned to make fire yet, they surely should have had a full conception of its horror, since fire is of manifold origins, and an act of God, like a stroke of lightning, or even a more commonplace occurrence, as spontaneous combustion, could have easily set an entire forest afire and deprived them of their dear possessions.

With the use and control of fire indicating the dawn of civilization and that man had ceased to be an animal, man began to realize that fire, although a boon and a luxury, was also a menace that needed to be watched and controlled. Consequently, crude forms of fire prevention came into existence, but these were more or less in the direction of fire extinguishment. Certain groups of people, seeking protection from outside exposure and realizing the importance of water in

case of a fire, began to build their houses on water. Others, being of a more superstitious nature, decided to honour fire as their divinity thinking that in so doing they could appease the wrath of the fire god and thus lessen his visitations.

An early indication of a more comprehensive understanding of the principles of fire prevention is had in the records of the Roman era.¹ Tacitus in his Annals tells us that shortly after the disastrous fire, A.D. 64, in Rome under Nero, "the several houses built on a new principle were to be raised to a certain elevation without beams and woodwork, on arches of stone..... that material being impervious, and of a nature to resist the force of fire." Later, A.D. 103, Emperor Trajan, writing to "Pliny the Younger", Pro-consul of Bithynia, concerning fire waste problems of that city, suggested: "....it will be more eligible, to make all possible preparation for extinguishing fires, to admonish the owners of the houses to be particularly careful in preventing such misfortunes".

Fire extinguishing apparatus, as the fire engine, had not been invented until 150 B.C.² by Ctesibius of Alexandria, and was at least used in Rome,

1. Walford's Insurance Cyclopedia, quoted in G.B. Gillespie's Fire Protection in Its Relation to Political Economy, pp.5-6

2. Ibid

being referred to by Pliny, in an earlier letter to Emperor Trajan, as an engine "to throw up water". It was later improved by Leopold of Germany and soon found its way into England in the early part of the seventeenth century. There Charles I called it an engine to "shoot water for quenching fires".

The great fire of London in 1666, entailing a loss of over 10,000,000 pounds sterling, was largely instrumental in awakening, directly, the English people and, indirectly, peoples of other lands, to the need of fire protection. Following this conflagration, the English government took great precautions to prevent further outbreaks. Organized insurance, as a sideline of fire prevention, also made its appearance being under the direction of one Dr. Nicholas Barbon who later in 1680 reconstructed the whole business into a company called "The Fire Office" with shareholders known at that time as "Undertakers". With this organization, it was immediately evident that fire insurance would assume the chief role in fire prevention, for "the Fire Office", shortly after it started to do business, published a pamphlet in which it was stated that the office was "assisted by the contrivance and industry of a company of men (meaning a fire brigade), versed and experienced in extinguishing and preventing

of the fire".³

The lot of the incendiarist has been hard from the very beginning. Section 25 of King Hammurabi's code,⁴ 2285-2242 B.C., provided that if for purposes of robbery, a man should set fire to a property, he "shall be thrown into that fire". Laws of retaliation of this nature ^{were} ~~was~~ also common ^{among} other peoples. In England, in time of Edward I, incendiarists were burnt to death and even as late as 1866 death by fire was the punishment meted out in Japan to incendiaries.

The foregoing observations serve to show that fire prevention is something that has come down from the past instead of the mere brain product of man of the present. It may have been brought to its present degree of development in America, but surely it must have had its beginning somewhere else. This is significant in these respects: that it was needed in the past, is needed at present, and will be so needed in the future. For if in the centuries of the making of man, he has spent time and labour continually on the fire waste problem and yet has been rewarded with results that are still not satisfactory, should he not continue to exert every mite of his energy on the same problem in the fu-

3. Ibid, p.11

4. Ibid

ture?

Fire Prevention Alleviates Fire Losses.--

The argument for better fire protection is not merely a historical one. The work itself has inherent virtues. Primarily, fire prevention means the reduction of fire losses and the elimination of their horrible aftermaths. In another chapter, we have briefly presented a picture of what fire loss is, and how the indirect losses of a fire usually amount to many times its direct toll. Reference was also had to incident losses of life, mutilation of limbs, and various sufferings of the body. By doing away with the hazard of fire, fire prevention also does away with the possibilities of such occurrence.

Benefits to the Insured, Insurer, and Society

at Large.-- Not only is fire prevention a boon to the parties more immediately concerned, the insured and the insurer,-- the former by giving him a reduced rate of premium, and the latter by enabling him to write risks with greater certainty and profit, but it benefits the nation as a whole. It may be true that the continuous burning of millions of dollars of worth of property may never have caused the least ripple on the commercial sea of America, but repeated recurrence of a waste of this na-

ture is a drain on the national treasury and a curse on the people. By successfully avoiding the repetition of conflagrations as the San Francisco and Baltimore fires and gradually checking the pyramiding of minor burnings until they reach a minimum, fire prevention benefits the nation at large.

Fire Prevention An International Problem.-

It would be narrow-mindedness to suppose that the benefits of fire prevention were confined within the limits of a nation. Directly and indirectly they reach the far corners of the earth. In at least two respects is this true:

(1) Fire prevention mitigates direct monetary losses due to the existence of insurance and reinsurance interests between nations. To an ever increasing extent, insurance companies are expanding their business throughout every desirable place on earth to assure the operation of the law of average and thus to secure financial stability. At the same time, so-called "home" companies in one country are willingly giving away part of their business to alien concerns, anticipating in return wider spread of business and, more important than that, protection against staggering losses in case of conflagrations. Both practices have created a common tie of

relationship between companies of different nationals. Thus, the conflagration of San Francisco depleted the reserves of many alien companies doing business in America. Meanwhile, alien insurance agencies with their home offices far back in distant countries were also called upon to unstring their purses since they had previously reinsured the business of some American companies as well as that of their own nationals operating in this country. Therefore, because of the existence of insurance and reinsurance interests between nations, successful fire prevention in one country ought to be viewed with joy by other countries at large.

(2) It prevents an undue rise in the price of goods from one country to another. Economists have long ago realized that no nation is entirely self-sufficient. There must be specializations, ^{each} ~~each~~ nation taking up what its climate, people, and location best dictate. In other words, the world is largely inter-dependent. This being so, what effect would it produce in America were a fire suddenly to rage in Brazil and destroy a large portion of the country including her warehouses and enormous coffee fields? The price of coffee would soar skyward. In like manner, if a fire were to wreck the major portion of London, England, would not the bill of her next shipment of rubber be increased

manifold? Conversely, could France sit merrily by the side of the Atlantic Ocean and watch New York burning away, without a fear that perhaps the next load of cargo coming from America would be charged with an extra fire tax? These observations, one and all, tend to show the importance of international co-operation in matters of fire prevention.

Yet they are by no means the only advantages. If space permits, we can enumerate one after another the various arguments that can be raised. For one thing, the broad-minded international economist hates to see untold millions of wealth going up ^{in smoke} in another country although he is not directly concerned. Further a sportsmanlike adversary dislikes to find his opponent handicapped by needless waste. Finally, the continued menace of fire is a threat to the well-being of the human species and as such must be fought off by those concerned.

In view of all these, it is clear that fire prevention is a common need of the entire world. The spirit of Locarno, of the League of Nations, and of whatever conferences in the past and in the future, may well pervade all civilized world with assurance of peace and prosperity. But have our great political thinkers ever stopped to consider that there is another

form of warfare, not man against man but man against the fire demon, that has taxed man's power utmost since the beginning of time? If not, they should be convinced that fire prevention, too, has international significance and should be regarded just as important as problems of peace parleys and reduction of armament.

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